



United States Department of Agriculture

Houston South Vegetation Management and Restoration Project Final Environmental Assessment



**Forest Service
Hoosier National Forest**

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Introduction

We are proposing to treat vegetation and conduct related management activities improving forest health and sustainability of the oak-hickory ecosystems while also improving wildlife habitat. The proposed project would move the Forest toward its desired future condition as identified in the 2006 Hoosier National Forest Land and Resource Management Plan (Forest Plan). These actions are proposed to be implemented on the Brownstown Ranger District of the Hoosier National Forest.

The 2006 Forest Plan with accompanying Environmental Impact Statement (EIS) and Record of Decision (ROD) as well as all subject matter expert professional reports are hereby incorporated into this Environmental Assessment (EA). We prepared this environmental assessment (EA) to determine whether to prepare an environmental impact statement or a finding of no significant impact.

Proposed Project Location

The majority of the project area is in the northwest corner of Jackson County on the Brownstown Ranger District. A small portion overlaps into the northeast corner of Lawrence County. All proposed harvests would occur on National Forest System (NFS) lands. Prescribed fire could be applied where adjoining U.S. Army Corps of Engineers land and private landowners express interest and are willing to enter into an agreement, and the proposed aquatic organism passages would be implemented on county roads and possibly near private land on the downstream side of one passage with prior approval.

The legal descriptions for the project area include:

- T7N, R2E, all or portions of Sections 14-16, 21-28 and 33-36
- T7N, R3E, all or portions of Sections 22-23, 26-30, and 31-36
- T6N, R3W, all or portions of Sections 2-6, 7-11, and 14-18
- T6N, R2E, all or portions of Sections 1-4, 10-12, and 13

Please refer to the attached maps for specific locations of proposed actions. Maps can also be viewed at our website at <https://www.fs.usda.gov/project/?project=55119>.

Houston South Vegetation Management and Restoration Project Vicinity Map Hoosier National Forest

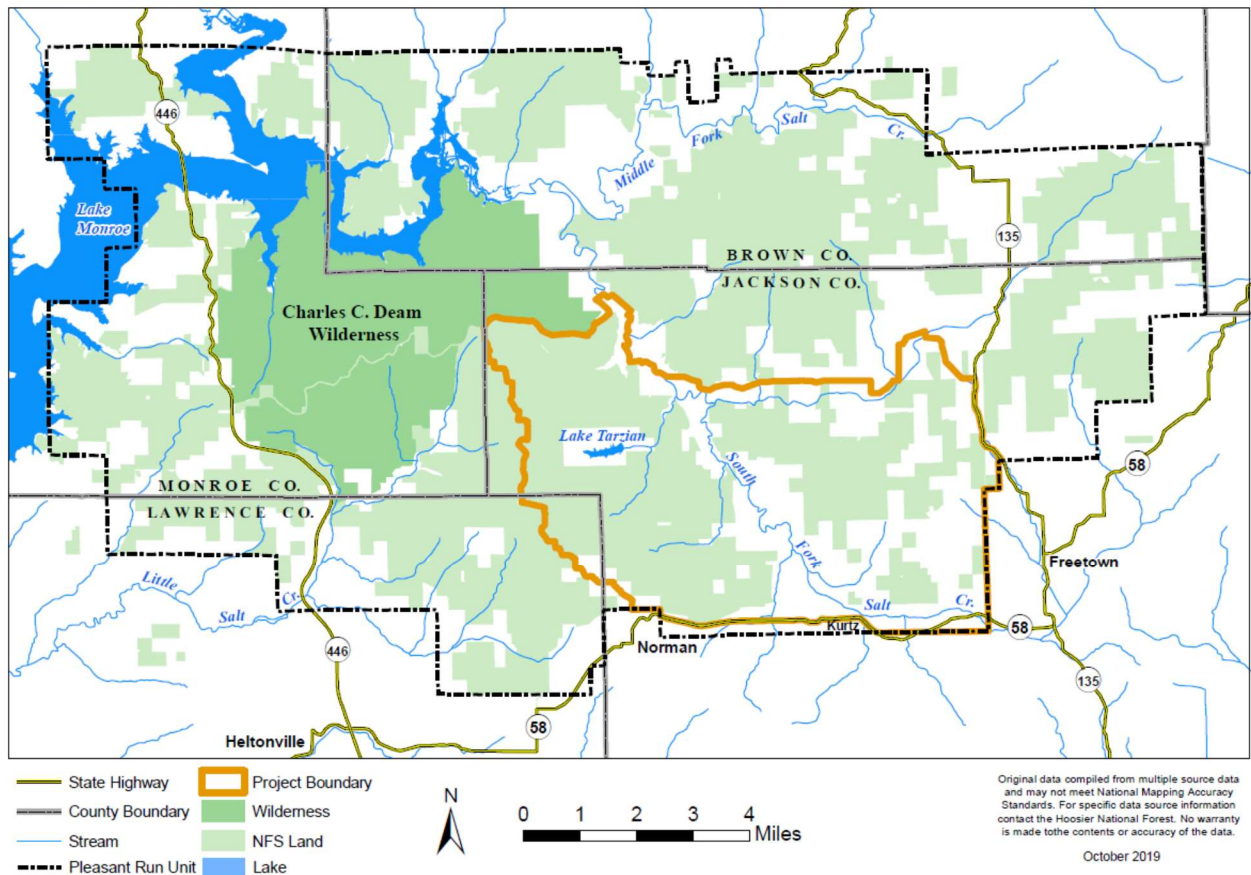


Figure 1. Vicinity map

Need for the Proposal

The Houston South Vegetation Management and Restoration Project (Houston South Project) proposed action is based on and would fulfill Forest Plan direction associated with the goal of maintaining and restoring sustainable ecosystems.

Current Conditions

The project area is currently dominated by mature forest. Stand data in the proposed silvicultural treatment area shows no stands in the 0 to 9-year age class, therefore the desired amount of early successional forest habitat described in the Forest Plan (4-12 percent) is not being met. Many stands are dominated by mixed-oak and oak-hickory canopies, but competitive oak regeneration does not exist across a majority of the project area. Understories and mid-stories in these stands typically consist of shade-tolerant species such as American beech and sugar maple, leaving very few areas where oak or hickory species are able to compete to be a part of a future stand. This trend is typical in contemporary forests where fire and management activities have been excluded for multiple decades.

The Forest Plan tells us “Without ecological restoration in the form of silvicultural treatments, oak systems will continue to decline (in terms of species richness and ecological function), converting from oak to mesophytic forests within a generation. Native wildlife species dependent on trees producing large-seeded acorns and nuts may be imperiled. To maintain the oak component, silvicultural systems need to be matched to the site characteristics combining harvest systems with regeneration treatments such as prescribed burning” (USDA FS 2006a).

There are approximately 500 acres of pine in the proposed silvicultural treatment area that is not native to the Hoosier National Forest. Pine plantations provide less suitable habitat and less biodiversity than native forests.

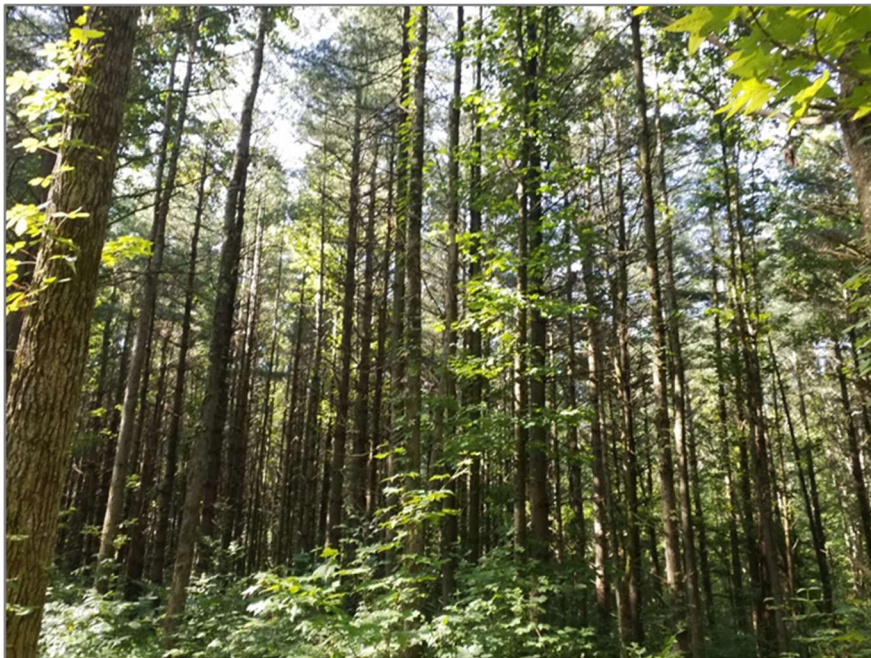


Figure 2: Overstocked non-native pine in the project area

Both the Houston South Restoration Project and the Hoosier National Forest fall within the Central Hardwood Region (CHR) as described by Johnson et al. (2009). The project area is typical of the CHR in both forest type and age class with the exception of the non-native pine plantations. Existing conditions for the project area are listed in Table 1.

Much of the project area is characterized by mature to over mature hardwood stands. Stands over 80 years old are typical, covering 55 percent of NFS lands in the project. Many of these stands consist of mature to over mature chestnut oak, white oak, and black oak as dominant canopy components. Many of these trees are at an age where they begin to naturally senesce (Figures 3 and 4).

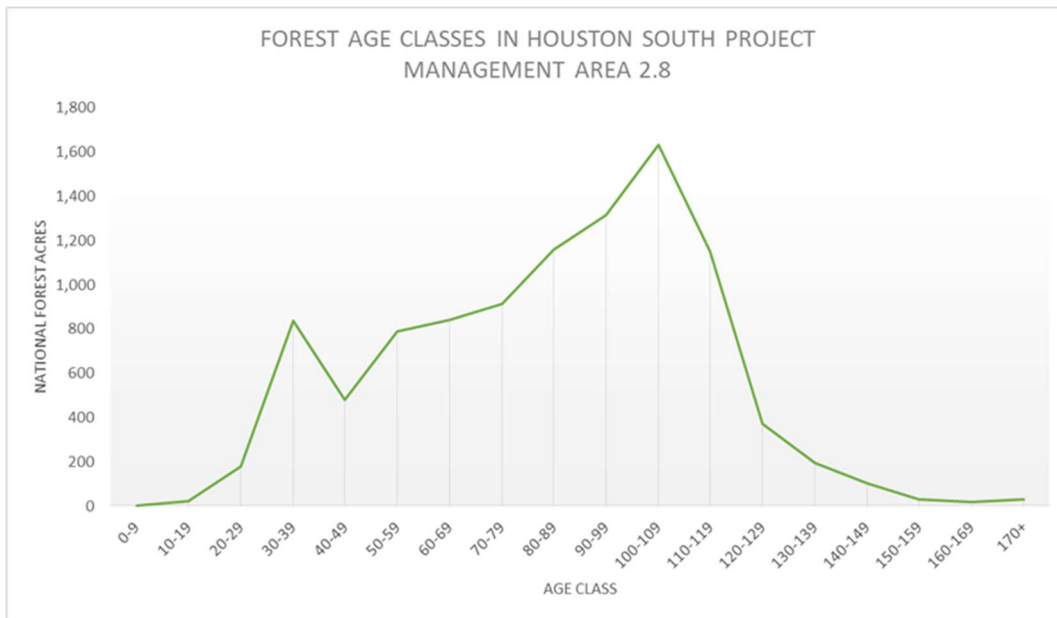


Figure 3. Forest age class distribution in the Houston South Project (Management Area 2.8)

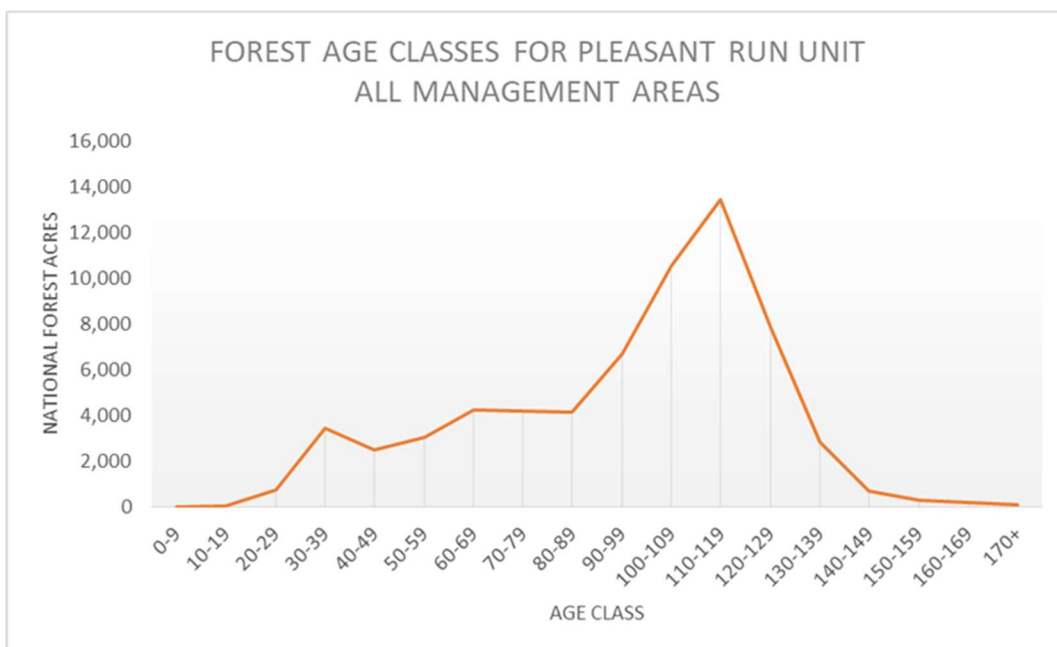


Figure 4. Forest age class distribution for the Pleasant Run Unit, Hoosier National Forest

Table 1: Summary of forest type by age class on NFS land in the Project Area (acres).

AGE CLASS	FOREST TYPE							
	Elm-Ash-Sycamore	Maple-Beech	Mixed Pine	Oak-Hickory	Oak-Pine	Shortleaf-Virginia Pine	White Pine	Grand Total
0-9	-	-	-	-	-	-	-	0
10-19	20	51	-	28	-	-	8	108
20-29	19	243	-	66	-	3	1	332
30-39	94	240	-	337	2	7	15	696
40-49	53	153	-	263	36	26	104	635
50-59	8	208	5	359	17	77	61	736
60-69	12	353	-	484	85	34	80	1,048
70-79	-	391	-	576	18	-	2	987
80-89	-	199	-	1,037	22	-	-	1,258
90-99	-	136	-	1,188	-	-	-	1,325
100-109	-	157	-	1,473	-	-	-	1,631
110-119	-	71	-	772	-	-	-	843
120-129	-	75	-	150	-	-	-	225
130-139	-	-	-	166	-	-	-	166
140+	-	-	-	80	-	-	-	80
Grand Total	207	2,280	5	6,978	180	148	272	10,071

For several millennia, oaks have been the predominate species on upland sites throughout much of the Central Hardwood Region (Abrams 2005). According to contemporary estimates, oak forest types comprise 51% of all forest lands in the east (Spetich et al. 2002), with the upland oak-hickory forest type covering over 100 million acres in the region (Sander et al. 1983). The oak-hickory forest type currently dominates canopies in the Houston South Project, covering 69 percent of all forested NFS land within the project boundary. Despite their widespread canopy dominance, the inability of oak reproduction to compete with large shade-tolerant advance reproduction and aggressive pioneer species has created concern about the sustainability of oak ecosystems (Lorimer 1993; Dey 2002; Brose et al. 2012).

Desired Conditions and Management Direction

The majority of the project is in Management Area 2.8. The desired conditions include maintaining 4 to 12 percent of the area in young forest habitat and diversity of age class and forest structure. The Forest Plan states, “The Forest manages the area primarily for plant and animal habitat diversity, and timber harvest is an appropriate tool for use in this area” (USDA FS 2006a). Portions of Management Areas 2.4, and 6.4 are included for prescribed burning, recognizing linkages between natural communities regardless of Management Areas and allowing the advantages of natural features as boundaries.

The diversity of age class and forest structure can be seen in Table 1, the forest is aging with nearly 76 percent of NFS forest stands over the age of 60 years and a lack of early successional (0-9 years) forest habitat.

Prescribed fire can create habitat conditions that are conducive to oak and hickory regeneration. Forest Plan guidance states, “use prescribed fire to accomplish silvicultural objectives such as oak regeneration” (USDA FS 2006a).

Purpose for Action

This proposal meets Forest Plan direction to promote tree growth, reduce insect and disease levels and move the landscape toward desired conditions. It would also increase the resiliency and structure of forested areas (stands) by restoring the composition, structure, pattern and ecological processes necessary to make these ecosystems sustainable.

Need for Action

This proposal is needed to provide a mosaic of forest conditions dominated by hardwoods and restore dry hardwood forest ecosystems that have not experienced periodic disturbance similar to fire or other naturally occurring events.

As maturing oaks and hickories age and die, they are being replaced by trees such as maple and beech. The hard-mast provided by oak-hickory species provides crucial food sources for a wide array of wildlife. Without management to limit competition from less desirable species, oak-hickory regeneration will continue to decline allowing demographic shifts to forested stands in the project area.

A lack of fire is also causing oak-hickory seedlings to be suppressed by a shade-tolerant mid-story. Reintroducing fire would promote regeneration and maintenance of mast producing oak and hickory.

There is a need to reduce the amount of pine in the project area to provide more suitable habitat to a wider array of wildlife species.

Pines were planted in the 1940's to the 1970's to aid in erosion control. Pines are not native to the Hoosier National Forest. As the nonnative pine stands mature, the canopy grows closer together and reduces the amount of sunlight reaching the forest floor. The ground beneath the stands, in many places, has little (if any) other plants growing to provide cover or food sources for wildlife.

By removing the pine plantations, the amount of forested habitat that is between 0 and 9 years of age would increase. The Forest Plan states the desired condition of this area is to maintain 4 to 12 percent of the area in young forest habitat. This creates important early successional habitat for a wide variety of songbirds, as well as ruffed grouse and American woodcock, both are Regional Forester Sensitive Species (See Figures 3 and 4). To provide for diversity in wildlife species, a range of habitats should occur across the landscape. Many wildlife species do not find browsing and other foraging habitat in

mature and maturing forests. Instead, they find the fruits, seeds, insects, and other food items they seek mostly in early successional habitat.

One of the reasons the proposal would occur in this area, is because stand densities are very high in portions of the project area and mortality is occurring. The proposal would reduce the density of the trees, improving forest health. Promoting healthy forest conditions and improving stand structure within the project area would improve the overall health of vegetation, creating an ecosystem more resilient to the effects of insects, disease, and climate change.

The Forest Leadership Team decided with input from specialists from different resource areas, that the Houston South area would be the next area to focus management activities to further support the implementation of the Forest Plan and to improve forest health. The Forest Plan, with extensive input from the public, designated this area as management area 2.8. The desired condition of this management area is a diversity of plant and animal habitat. Active forest management is an appropriate tool in this area. Since the 2006 Forest Plan was implemented, active forest management including timber harvest and other vegetation management activities has focused on the southern end of the forest over the course of four different project areas, two of which were in management area 2.8. The Forest Leadership team decided it was appropriate for the next active forest management proposal to be in the Houston South area.

There are also opportunities to repair poorly maintained roads and eroded areas to reduce sediment deposition into streams and lakes in the project area. Additionally, roads and trails may be better located to reduce sedimentation and increase viability of aquatic organisms. These actions may include relocating, reconstructing, or obliterating roads and possible placement of aquatic organism passages (large culverts) in the project area.

Figures 5 and 6 are images of early successional forest habitat created as part of the Oriole Restoration Project on the Tell City Ranger District.



Figure 5: Clearcut, 2 years post-harvest



Figure 6: Clearcut, 4 years post-harvest

Public Involvement and Tribal Consultation

On September 6, 2018 staff of the Hoosier presented and discussed the early stages of this proposal at a public meeting in Bedford, Indiana. Forest Supervisor Michael Chaveas delivered a presentation that included the proposal and took questions at the Monroe County public library on October 25, 2018.

On November 26, 2018, the scoping letter (USDA FS 2018) was posted on our website, 218 hardcopy letters were mailed, and 84 emails were sent with the scoping letter attached. Press releases were sent to multiple newspapers announcing the proposed project. We received questions and comments from 93 respondents. All comments and our responses to them can be found on the project website:

<https://www.fs.usda.gov/project/?project=55119>. All comment letters are in the project record at the Hoosier National Forest Supervisor's Office in Bedford, Indiana.

The Forest also published project information in the Schedule of Proposed Actions (SOPA), which lists project and contact information. The Hoosier's SOPA, can be found at <http://www.fs.fed.us/sopa/forest-level.php?110912>.

The project was first introduced to our tribal partners in a conference call presentation on October 19, 2015. The project was then presented formally in a consultation letter to the State Historic Preservation Officer on November 4, 2015 requesting concurrence to findings of the first archaeological report of investigations for the project. On November 16, 2018, invitations to consult on the project were sent to the six federally recognized tribes that consider southern Indiana their ancestral homelands. These tribes are the Absentee Shawnee Tribe of Indians of Oklahoma, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Miami Tribe of Oklahoma, Peoria Tribe of Indians of Oklahoma, and the Shawnee Tribe. The Absentee Shawnee Tribe of Oklahoma had no objection to the project and requests notification in the event human remains or other cultural resources are discovered. The Miami Tribe of Oklahoma responded that they had no objection to the project and requested immediate consultation if any human remains or Native American cultural items falling under the Native American Graves Protection and Repatriation Act or other archaeological evidence is discovered during any phase of this project. The Shawnee Tribe responded that they had no issues or concerns but request notification if archaeological material is discovered during project implementation.

Proposed Action and Alternatives

Proposed Action

The Forest Service is proposing to conduct approximately 1,104 acres of even-aged management, 2,405 acres of thinning in both pine stands and hardwoods, and 462 acres of selection harvest in hardwood stands. Approximately 234 acres are proposed for midstory removal treatments. Midstory removal treatments remove trees in the mid-story without breaking the canopy. This produces light conditions below the canopy that allows

oak seedlings to develop without increasing the competition from shade-intolerant species. Approximately 170 acres are proposed for crop tree release. Crop tree release is a treatment designed to free young trees from competing vegetation. The enclosed map displays the proposed silvicultural treatments in the project area.

Table 2 lists the proposed activities. These figures are approximate and represent the maximum.

Table 2: Proposed activities in the project area

Proposed Activity	~ Unit of Measure
Clearcut (Pine)	401 acres
Shelterwood	703 acres
Thinning (Pine)	78 acres
Thinning (Hardwood)	2,327 acres
Selection	462 acres
Midstory Removal	234 acres
Crop Tree Release	170 acres
Total silvicultural treatments	4,375 acres
Herbicide Spot Treatment	1,970 acres (allowed within)
Prescribe Fire	13,500 acres
New Road Construction	3.2 miles
Temporary Road Construction	8.3
Road Reconstruction	4.9 miles
Road Decommission	2.7 miles
Aquatic Organism Passages	3 structures

Clearcut – 401 acres

Clearcut harvests are regeneration cutting methods in even-aged management. This treatment is assigned to non-native pine plantations. Per the Forest Plan, clearcut harvests are used when they are the optimum harvest method to achieve stated management objectives such as conversion of non-native pine to native hardwoods and providing habitat for early successional forest species. For this treatment, with the exception of trees that are left for wildlife, all trees in an area would be harvested at one time.

Shelterwood - 703 acres

Shelterwood harvests are regeneration cutting methods in even-aged management. Shelterwood harvests are defined as the cutting of most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment (Helms 1998). The goal of the shelterwood system in this project is to establish and foster advance oak and hickory seedlings to ensure oak ecosystems are perpetuated on the landscape following the final overstory removal. Shelterwood systems can be completed in either two or three stages.

Hardwood and Pine Thinning - 2,327 and 78 acres, respectively

This treatment is assigned to overstocked hardwood and pine stands. Thinning is considered an intermediate treatment aimed at reducing stand densities to improve growth, enhance forest health, and recover potential mortality (Helms 1998). Thinning is considered an appropriate treatment for stands without adequate regeneration in place prior to harvest. In general, thinning prescriptions would reduce stand densities by approximately one-third.

Selection - 462 acres

Selection harvests are a form of uneven-aged management. Single-tree selection seeks to remove individual trees from all size classes more or less uniformly throughout the stand. The objective of this treatment is to promote growth of the remaining trees and provide space for regeneration (Helms 1998). It also promotes age class diversity by removing large, senescing trees to create individual tree gaps capable of recruiting younger midstory trees to the upper canopy. This technique often favors shade-tolerant trees and is prescribed on mesic sites. Approximately one-third of the density would be removed from the stand.

Group Selection is a system in which trees are removed and new age classes are established in small groups (Helms 1998). Individual groups may not be larger than 3 acres (USDA FS 2006a). Single-tree selection would be implemented between the groups. Groups are determined at the time of sale layout by evaluating ground conditions.

Midstory Removal - 234 Acres

Midstory removal is assigned to stands where oak-hickory species dominate canopies but little to no oak-hickory regeneration is apparent. This treatment involves, with the exception of trees left for wildlife, removal of all midstory stems to enhance light conditions below the upper canopy. This is not a commercial treatment.

Crop Tree Release - 170 Acres

Crop tree release is a widely applicable technique used to enhance the performance of individual trees (Miller et al. 2007). It is an intermediate silvicultural treatment intended to provide increased growing space to selected trees through the removal of crown competition from adjacent trees. This is not a commercial treatment.

Selective herbicide applications are proposed for site preparation and stand improvement activities on 1,970 acres. Herbicide would be applied specifically to the trunks and stumps of targeted woody vegetation resulting in a relatively small area of application with little to no herbicide contacting the soil.

Prescribed fire is proposed to create habitat conditions that are conducive to oak and hickory regeneration and reduce fuels created through timber harvest. Depending on adjacent landowner participation, approximately 9,700 to 13,500 acres of prescribed burning is proposed. Prescribed burning would only take place on private land with the approval of the land owner through a formal agreement and after all appropriate surveys have been completed.

Not all available acreage would be burned during any given year. The burn acreage would be split up into smaller units in areas with or without timber harvest across the project area. Annual acres burned for this project would average approximately 1,500 acres. These treatments would be repeated periodically to reach and then maintain the desired condition. Burning under a suitable prescription would return the vegetation to a vigorous condition that would benefit wildlife and promote oak and hickory regeneration.

The boundaries for these treatments would largely take advantage of topography and other features such as roads and trails. Fire lines that are necessary to control fire on the landscape would be constructed using non-ground disturbing tools such as leaf blowers and chainsaws. These tools allow crews to remove fuels from the forest floor and above, reducing the chances that a fire would be carried outside of the desired burn location. While creation of fire lines in this manner changes habitat in the short-term, they tend to return to their previous state more quickly than when constructing fire lines down to bare mineral soil.

To access the areas proposed for treatment, approximately 3.2 miles of new road construction would be added to the current road system and 8.3 miles of temporary road, totaling 11.5 miles of road construction, as well as road reconstruction for approximately 5 miles. All standards and guidelines prescribed in the Forest Plan related to this type of work would be followed. Proposed lengths of roads are estimates.

When practical, roads would be rehabilitated to reduce erosion, correct drainage problems, and reduce illegal access from all-terrain vehicles. Approximately 3 miles of roads no longer needed would be removed from the system by decommissioning. Installation of vernal pools at some decommissioned road sites could occur to prevent illegal off-road vehicles use while benefiting wildlife.

There may be an opportunity to replace two undersized culverts and one undersized concrete structure with appropriately sized structures that would allow for aquatic organism passage (AOP) and allow natural material transfer that is currently stored unnaturally upstream. Removal and replacement of these crossings is needed because the structures do not allow for upstream passage of native fish species as well as other aquatic organisms. Proper sized crossings also restore a more natural flow regime with less impedance. Natural flow regimes promote less excessive bank erosion and helps mitigate channel incision.

If implemented, the AOPs would be constructed on Tower Ridge Road at Combs Branch, County Road 825 North at Callahan Branch, and County Road 980 West at a tributary to Tipton Creek. The implementation of these AOPs would help improve approximately 14 miles of upstream habitat. The three proposed AOPs are located within the South Fork Salt Creek Watershed.

The project proposes to use sections of trails during the timber harvests, potentially affecting portions of Hickory Ridge trail system and the Fork Ridge Trail. During project implementation, we would close certain sections of these trails for safety. We would stage project implementation appropriately to minimize impacts on trail use.

There are known cultural resources in the project area. To avoid inadvertent disturbance of these areas, 10 to 20-meter buffer zones would be established to protect potentially significant cultural resource sites. Any cultural resource sites that require protection from fire would require both indirect and direct methods of protection. Examples include placing protective fire shelters over vulnerable features or using leaf blowers to reduce fuels adjacent to protected resources.

It is expected that project implementation would begin in 2020 and would take place in stages over time taking several years to complete. The work would be completed using contracts as well as Forest Service employees.

Design Measures included in the Proposed Actions

As part of project development, the ID team developed design measures (or implementation requirements). Appendix A contains design measures that would be required if the decision maker decides to implement the action alternative. The Environmental Effects section describes the effects of implementing the alternatives with design measures included.

No Action Alternative

The No Action Alternative is the continuation of the current level of management and use. There would be no project-related treatment with this alternative. Under the No Action Alternative, the existing conditions would continue. The No Action Alternative provides a baseline to compare the environmental effects of the action alternative.

Environmental Effects

Issues

This section includes the issues that have been identified for detailed analysis because the impacts of the proposed action and alternatives may be related to potential significance or the ability to meet the need of the project. The following issues were identified and analyzed to determine the potential for significance:

Effects Related to Relevant Issues

This section discloses the environmental impacts.

Issue 1: Prescribed burning could have negative effects on water quality, soils, and air quality; could cause loss of herbaceous layer, invasive plant introduction, soil acidification, nutrient runoff, greenhouse gas release, and carbon release.

Indicators:

- Particulate matter (PM 2.5)
- Erosion and sedimentation rates from prescribed fire

- Potential to further spread non-native invasive plants
- Local GHGs emissions
- Carbon release from prescribed fire
- Miles disturbed for fire line construction

For Issue 1: Analysis Area:

The spatial boundary used to evaluate direct and indirect effects is the Houston South Vegetation and Restoration Project boundary. The spatial boundary to evaluate cumulative effects is the Project Boundary with an additional 1000-foot buffer (NNIS introduction), South Fork Salt Creek Watershed (soils, water quality, nutrient run-off), Brownstown Ranger District boundary (air quality), Hoosier National Forest boundary (carbon release), and the global atmosphere (GHG emissions). The temporal consideration for cumulative effects is 20 years, as prescribed fire treatments would be likely completed in this timeframe.

Direct and Indirect Effects for Issue 1**Proposed Action**

Hoosier fire monitoring data shows that prescribed burning under normal circumstances has no effect on soil and water resources due to the thick duff layer remaining post-burn, preventing soil displacement until the area re-vegetates (which usually occurs in 45 days or less in this project area). Fire effects monitoring has found evidence of ample vegetative regrowth six months after prescribed burning (Rigg and Larson 2007).

Prescribed burning on the Hoosier typically occurs in the cool season, with low intensity fires. This helps lessen the loss of nutrients and reduce the overall level of sediment runoff into streams. Moist riparian areas do not carry fire well, so these would likely remain unburned, retaining their filtering capabilities.

Fire lines necessary to contain prescribed fire would be constructed in appropriate areas within the project area. These lines are generally placed a short time before the burn is to occur and are constructed using mowers, chainsaws and leaf blowers. Creation of fire lines in this manner would alter the immediate habitat for the short-term, and these features will return to their previous state more quickly than when fire lines are constructed to bare mineral soil using shovels, heavy equipment, or other tools. A limited amount of fire line may need to be constructed using heavy equipment (159 feet). If heavy equipment is used, Forest Plan standards and guidelines and BMPs would be used to avoid negative effects.

Prescribed fires on the Hoosier typically are lower intensity due to climate and vegetation, so substantial effects to nutrients and organic matter breakdown are not expected.

Low-severity prescribed fire has a minimal effect on soil biota. The maximum temperatures are generally nonlethal, except for the upper litter layer, and therefore the consumption of forest floor habitat is limited (Neary et al. 2005).

A study by Elliot and Vose (2005) to investigate effects of prescribed burning on soil solution chemistry and streamwater quality suggest that low intensity, low severity prescribed burns could be used to restore vegetation structure and composition in mixed pine-hardwood ecosystems without negatively impacting water quality.



Figure 7: Fork Ridge approximately 2 months post-burn

A prescribed fire was completed at Fork Ridge April 3, 2019. Shortly after the burn, several areas were checked to see the amount of O layer (organic matter such as decomposing leaves) that was consumed on different facing slopes. Unburned areas and differences in O layers showed that fire has a negligible effect in relation to organic material. Visual observation had a similar mosaic burn pattern throughout.

Soil-stabilizing vegetation after burning recovers within six months

of the prescribed burn (Rigg and Larson, 2007). Figure 7 was taken of the Fork Ridge burn on June 13, 2019 verifying quick re-vegetative growth.

The direct and indirect effects to air quality of the proposed prescribed burning would be of short duration (less than 24-hours). As a federal agency, the Forest Service must comply with all federal, state, and local laws and regulations concerning air quality. In Indiana these include State Implementation Plans for attaining and maintaining national ambient air quality standards (NAAQS) and visibility goals under the Regional Haze Rule. The desired condition for air quality is continued compliance with the NAAQS within the analysis area and minimizing the intermittent impacts of smoke to all sensitive areas.

Air quality within the analysis area is currently meeting the NAAQS for ozone and fine particulates. This means that current sources of pollution, including intermittent emissions from prescribed fire, are not causing air quality to exceed the current thresholds established to protect human health and welfare. Based on existing air quality information, no long-term adverse impacts to air quality standards are expected from the proposed project (Ash and Kolaks 2019). The proposed project is designed to ensure that the Basic Smoke Management Practices are followed and does not threaten to lead to a violation of any Federal, State or Local law or regulation related to air quality. However, there may be times when smoke from the proposed prescribed fires causes short-term respiratory discomfort, is a nuisance, or reduces visibility of those near the burn units. Although burns are planned to minimize these impacts to smoke sensitive areas and nearby residents, there is the potential for the smoke plume to change direction and temporarily affect those in its path. These impacts are short-lived and last less than 24 hours. Impacts may also occur some distance downwind depending on the weather

conditions. This is particularly the case for burn units that may contain higher than normal fuel loads due to insect and storm damage, and lack of regular fire treatments. For these reasons, smoke management planning is an integral part of each prescribed burn operation.

Prescribed burning produces mixed effects on nonnative invasive species (NNIS) plants depending on the individual species, the timing of the burn, and fire intensity. Burning contributes to disturbance that can create conditions susceptible for new invasive plant invasion or expansion of existing infestations. Fire would create a nutrient flush for a short period that would benefit both native and invasive plants.

Where appropriate and feasible, the Forest would implement actions that would include the use of manual, mechanical, and herbicide techniques for control of NNIS plants according to the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a).

Design measures, such as requiring equipment to be cleaned and inspected before entering the project area, were developed to decrease NNIS introduction and spread. Appendix A contains the list of project design measures.

Carbon emissions during the implementation of the proposed action would have only a temporary influence on atmospheric carbon. The proposed activities in the Houston South project are not considered a major source of greenhouse gas (GHG) emissions. Forested land will not be converted into a developed or agricultural condition or otherwise result in the loss of forested area. In fact, forest stands are being retained and harvested and prescribed burned to maintain a vigorous condition that promotes tree growth and productivity, reduces insect and disease levels and supports sustainable ecosystems, thus contributing to long-term carbon uptake and storage (Dugan 2019).

Forest management activities such as harvests and prescribed burns have characteristics similar to disturbances that reduce stand density and promote regrowth through thinning and removal, making stands and carbon stores more resilient to environmental change (McKinley et al. 2011). The relatively small quantity of carbon released to the atmosphere and the short-term nature of the effect of the proposed actions on the forest ecosystem are justified, given the overall change in condition increases the resistance to insects, disease, wildfire, age related declines in productivity, or a combination of factors that can reduce carbon storage and alter ecosystem functions (Millar et al. 2007, D'Amato et al. 2011). Furthermore, any initial carbon emissions from this proposed action will be balanced and possibly eliminated as the stand recovers and regenerates, because the remaining trees and newly established trees typically have higher rates of growth and carbon storage (Hurteau and North 2009, Dwyer et al. 2010, McKinley et al. 2011).

No Action

If the no action alternative were to be selected, no prescribed burning would occur in the project area, resulting in a continuation of present natural community succession and lend to the decline in oak/hickory regeneration.

This alternative would have no direct effects on air quality since no actions would be implemented. Indirectly, this alternative could impact air quality later due to resulting build-up of forest fuels, which could cause more smoke over longer durations if intense wildfires were to burn areas not treated (unlikely except in a drought year).

Active nonnative invasive plant colonization and establishment as influenced by ongoing activities within the project area would continue at current rates. Any change to the rate of spread of NNIS plants would depend upon existing Forest projects that overlap the project area and any other future invasive plant control done according to the Nonnative Invasive Species Plant Control Program Analysis within or adjacent to the project area (Table 6). The rate of spread, however, under the no action alternative for the action area and for lands immediately adjacent would be less because it would not increase ground disturbance. Risks to rates of NNIS plant expansion under this alternative would depend upon human disturbances and available funding to mitigate effects caused by those actions not associated with the Houston South project.

There would be no timber or prescribed fire treatments implemented under this alternative. In the absence of timber harvesting on the stands where proposed under the Proposed Action, stand densities would continue to increase causing competition for limited resources. This could lead to tree stressors that lend themselves to increased insect and disease outbreaks and mortality, decreasing the resilience of forests to climate-related environmental changes. Eventually, the forest would thin naturally resulting in dead trees that would decay in the long-term, emitting some carbon to the atmosphere, which may or may not be offset by forest growth.

Cumulative Effects for Issue 1

Multiple prescribed fires could occur on the same day within the analysis area if burning conditions were favorable, and equipment and staffing were available. Multiple burns occurring at the same time could cumulatively increase particulate levels. Should other burns be scheduled, communication between prescribed fire managers is essential to minimize the chances of smoke from multiple burns merging, whether they are ignited on the same or consecutive days.

As a result of the pre-planning and effective smoke management as required throughout the burns, the overall magnitude of effects are within the standards set to protect public health and safety. No significant cumulative effects would result from implementation of the proposed action.

Invasive plants will continue to invade and spread across the landscape. The cumulative effect of implementing the action alternative combined with ongoing human and natural disturbances is the continuing spread of these species. The actions and processes differ in

various locations in the project area and across the Forest, so the rate of spread would also differ. Vehicles, equipment, wind, rain, animals, and humans have the potential to carry invasive plant seed to new and currently uninfested areas. This spread really has no limit other than the susceptibility of the receiving habitats. Given the inherent susceptibility of some habitats across the Forest and within the project area, spread is likely. At the same time, Forest-wide NNIS plant management and site-specific project level control activities are increasing, which could result in reduced invasive plant populations in areas of treatment for the Houston South project.

Past and present disturbances, when added to reasonably foreseeable actions, have an effect on the expansion of NNIS through distribution of seed, ground disturbance, and the creation or perpetuation of spread vectors. The degree of effects would vary depending on the number of entrances over time, distribution of disturbance across the Forest, the proximity of infestations, and number of acres disturbed. The Hoosier is intermixed with lands of other ownerships. Since invasive plant infestations occur at widely scattered locations on both private and NFS lands, land use decisions made by other owners may affect the spread of invasive plants as much as activities carried out by the Hoosier.

Continued implementation of the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a) in selected portions of the project area where most needed according to the identified treatment priorities, would work against the cumulative effect of many other activities, which are creating conditions for the spread of NNIS.

Because the direct and indirect effects of prescribed burning related to GHG release and carbon release would be negligible, the proposed action's contribution to cumulative effects on global GHGs and climate change would also be negligible. Carbon would be removed from the atmosphere with time as the forest regrows, further minimizing or mitigating any potential cumulative effects.

Issue 2: Concern that trails used for hauling timber could cause erosion

Indicators:

- Miles of trails used for harvest

Issue 3: Concern that timber harvest could cause soil erosion during and after harvest

Indicators:

- Percent of project area affected by soil disturbance

Issue 4: Concern that timber harvest and road construction could cause sedimentation and nutrient loading in the watersheds of Lake Monroe

Indicators:

- Percent of project area affected by soil disturbance
- Miles of new road construction

For Issues 2-4: Analysis Area:

The spatial boundaries used to evaluate direct effects are the areas with proposed actions within the Houston South Project boundary. This spatial boundary was chosen because it can be used to determine threshold effects to soil and water quality from proposed actions.

The spatial boundary used to evaluate indirect and cumulative impacts is the 10-digit hydrologic unit (HUC 10) South Fork Salt Creek watershed. This cumulative effects boundary permits the assessment of effects from any past, present, and reasonably foreseeable future projects that overlap in time and space with effects to soil and water from the proposed action. Cumulative effects, beyond the project site watershed boundary, diminish below measurable levels and cannot be meaningfully evaluated. The timeframe of consideration for effects to soil and water is 12 to 15 years because silvicultural treatments would be complete by this period. Sedimentation effects to water resources are not expected to exceed one complete vegetative growing cycle after project completion because the combination of vegetative growth and lessened disturbance provide protection from sediment movement.

Direct and Indirect Effects for Issues 2-4**Proposed Action**

Direct effects to soil and water from initial disturbance which may affect soil productivity and water quality are: soil decomposition (compaction, rutting, and movement), localized erosion/sedimentation, and water pollution. “Localized” infers that qualitative and quantitative measurable impacts do not progress beyond the project boundary.

Although new roads on undisturbed ground would be needed, there are many old road corridors throughout the project area that follow ridge tops. When planning the transportation system for the project, these existing linear scars were used to minimize soil and watershed impacts. New construction would convert these old road corridors to new roads. Road reconstruction would require maintenance to bring old roads up to current transportation specifications. Landings and skid trails would be used mostly on ridgetops and flat areas to minimize disturbance.

A total of 16.4 miles of road work is proposed to access timber. Road construction/reconstruction activities that would impact the landscape include, but are not limited to: culvert installations, natural material fords, drainage dip construction, clearing corridors, aggregate placement, and earthwork. Effects from the road work would be short-term sedimentation of drainages and movement of some of the earthwork material downhill. Erosion control methods, along with seeding and mulching of disturbed areas, would minimize these effects. It has been found that disturbed areas heal themselves within two

to three years. Long-term effects may include blockage of aquatic organism passage in drainages due to improper culvert installations, taking ground out of production, degradation of drainages due to ford crossings, and movement of aggregate surfacing off the roadway due to routine road maintenance and during heavy rain events. Compaction, loss of water infiltration, and loss of overall long-term soil productivity are to be expected with road construction.

Proposed constructed road locations are mainly on high ground and only intermittent or ephemeral streams would be crossed for new road construction. Road approaches to streams would be located to minimize erosion and sediment introduction to the stream. Roads would generally cross channels at right angles. Channel crossings would be accomplished using appropriate crossing structures according to site specific conditions. Natural hydrologic drainage regime should be maintained with adequate drainage structures and design. Road surfaces should be maintained using aggregate or suitable erosion control cover within riparian corridors (USDA FS 2006a).

There are several degrading roads and trails that are negatively impacting the South Fork Salt Creek Watershed due to sedimentation. Rehabilitating these roads and trails to specification would minimize erosion instead of exacerbating at the current rate.

Timber harvest activities have the potential to cause detrimental soil disturbances. These disturbances can adversely affect soil productivity and water quality. The Forest Service has a practical method of monitoring soil disturbance with set thresholds. Site quality is projected to be maintained if detrimental soil disturbance (DSD) is less than 15% of an area (Powers 1998). Approximately 454 acres (10% of harvest area) of soil would potentially be detrimentally disturbed due to road construction and reconstruction, as well as landing, skid trail, AOP, and fire line construction.

A complete soil analysis was conducted based on risks posed by harvesting. Many of the soils are moderate to high risk erodible silt loams based on structure and slope. Table 3 displays interpretations for activities for the soil map units inventoried and delineated for the entire the Houston South proposed action area. Soil interpretations related to use of ground-based equipment, excerpted from NRCS soil survey include interpretations of hazard or risk for erosion hazard and harvest equipment operability. Detailed descriptions of these interpretations are in the project file for the Houston South project.

Table 3: Soil types and soil ratings in the project area

Map Unit Symbol	Map Unit Name & Percent Slope	Erosion Rating	Harvest Equipment Operability
AddA	Avonburg silt loam, 0 - 2%	Slight	Moderately suited
BbhA	Bartle silt loam, 0 - 2%	Slight	Moderately suited
BcrAW	Beanblossom silt loam, 1 - 3%	Moderate	Moderately suited
BdoB	Bedford silt loam, 2 - 6%	Moderate	Moderately suited
BnwD2	Bonnell silt loam, 12 - 18%	Very Severe	Moderately suited
BocD3	Bonnell silty clay loam, 10 - 18%	Severe	Moderately suited

BvmG	Brownstown channery silt loam, 25 - 75%	Very Severe	Poorly suited
BvoG	Brownstown-Gilwood silt loams, 25 - 75%	Very Severe	Poorly suited
CkkB2	Cincinnati silt loam, 2 - 6%	Moderate	Moderately suited
CkkC2	Cincinnati silt loam, 6 - 12%	Severe	Moderately suited
CkkC3	Cincinnati silt loam, 6 - 12%	Severe	Moderately suited
ComD	Coolville silt loam, 12 - 20 %	Very Severe	Moderately suited
DfnA	Dubois silt loam, 0 - 2%	Slight	Moderately suited
DfnB2	Dubois silt loam, 2 - 6%	Moderate	Moderately suited
FkoD2	Frederick-Crider-Gilwood silt loams, 6 - 18%	Severe	Moderately suited
GgeD	Gilwood-Crider silt loams, 6 - 20%	Severe	Moderately suited
GghD	Gilwood-Wrays silt loams, 10 - 25%	Very Severe	Moderately suited
GmrD3	Gnawbone silt loam, 12 - 18%	Severe	Moderately suited
GmrF	Gnawbone silt loam, 25 - 55%	Very Severe	Poorly suited
HccA	Haubstadt silt loam, 0 - 2%	Slight	Moderately suited
HccB2	Haubstadt silt loam, 2 - 6%	Moderate	Moderately suited
HcgAH	Haymond silt loam, 0 - 2%	Slight	Moderately suited
HheF	Hickory loam, 15 - 45%	Very Severe	Moderately suited
HsaB2	Hosmer silt loam, 2 - 6	Moderate	Moderately suited
KxvD2	Knobcreek-Crider-Gilwood silt loams, 6 - 18%	Severe	Moderately suited
MhyB2	Medora silt loam, 2 - 6%	Moderate	Moderately suited
MwhA	Muren silt loam, 1 - 3	Slight	Moderately suited
NaaB2	Nabb silt loam, 2 - 6%	Moderate	Moderately suited
NehF	Negley loam, 18 - 35%	Severe	Moderately suited
NerD2	Negley silt loam, 12 - 18%	Severe	Moderately suited
OmkC2	Otwell silt loam, 6 - 12%	Severe	Moderately suited
OmkC3	Otwell silt loam, 6 - 12%	Severe	Moderately suited
Omz	Orthents, earthen dam	Not rated	Not rated
PcrB2	Pekin silt loam, 2 - 6%	Moderate	Moderately suited
PhaA	Peoga silt loam, 0 - 1%	Slight	Moderately suited
PlpAH	Piopolis silty clay loam, 0 - 1%	Slight	Poorly suited
PlpAHU	Piopolis silty clay loam, 0 - 1%	Slight	Poorly suited
Rbld3	Rarden silty clay loam, 12 - 18%	Severe	Moderately suited
RcsC3	Rarden silt loam, 6 - 12%	Severe	Moderately suited
SoaB2	Spickert silt loam, 2 - 6%	Moderate	Moderately suited
SoaC2	Spickert silt loam, 6 - 12%	Severe	Moderately suited
StaAH	Steff silt loam, 0 - 2%	Slight	Moderately suited
StaAQ	Steff silt loam, 0 - 2%	Slight	Moderately suited
StdAH	Stendal silt loam, 0 - 2%	Slight	Moderately suited
StdAQ	Stendal silt loam, 0 - 2%	Slight	Moderately suited
SukC2	Stonehead silt loam, 4 - 12%	Severe	Moderately suited
SvgA	Stoy silt loam, 0 -2%	Slight	Moderately suited
WgwD2	Wellrock silt loam, 12 - 18%	Severe	Moderately suited

A combination of soil and site physical properties or characteristics in six soil map units identify “soils of concern” for the project area. These soil map units require additional

consideration and management throughout the various phases of activity to maintain or enhance soil quality and productivity in its existing condition. These map units are: Brownstown channery silt loam (BvmG), a Brownstown-Gilwood silt loams (BvoG), Coolville silt loam (ComD), Gilwood-Wrays silt loams (GghD), Gnawbone silt loam (GmrF) and Hickory loam (HheF). The properties of concern are related to very steep slope gradient, 45% or higher, shallow soils, and soil moisture conditions. These soil map units have high erosion potential, slope failure potential and present challenges to equipment operation.

Soil erosion risk on these soils of concern is minimized by reducing the areas where equipment operates, locating landings on relatively flat ground that can be properly drained, locating skid trails on slopes less than 35 percent, and using erosion control features such as water bars and leaving woody debris on site following harvest operations. The debris would protect the soil from splash erosion impacts and presents physical barriers to soil movement (USDA FS 2006b). Further erosion risks can be minimized with pre-operation location and design of access routes, avoiding existing or predicted unstable slope areas where possible, installation of adequate road drainage during and after operation periods, and prompt rehabilitation of disturbed or excavated soils to restore protection from storm flow and maintain soil productivity. Additionally, harvest operations in a specific harvest unit are generally conducted in one season, and this would typically have fewer impacts on soils resources than operations that continue season after season (USDA FS 2006b).

The normal operating season in our contracts is in the driest part of the year (summer/fall), further limiting soil compaction possibility and other impacts. Contractually, restrictions on operations on the most sensitive soils can be made to avoid resource impacts.

The contract can define the types of equipment allowed, such as dozer only areas, restricting equipment to staying on designated trails, or having purchasers winch trees to equipment on the trails, etc. Frequent timber sale inspections, especially on areas of high concern or marginal weather days, would occur.

This proposed disturbed area would be evaluated by implementing the Forest Disturbance Monitoring Protocol (USDA FS 2009b). Pre-harvest and post-harvest monitoring activities would be implemented at the start and end of the Houston South project to assess that the 15 percent of detrimental disturbance has not been exceeded. Forest Disturbance Monitoring Protocol rates disturbance using these indicators: reduction in organic soil layers, soil displacement, rutting, charred soil (light, moderate, severe) and compaction (platy or massive soil structure).

There are inherent risks to soil and water resources just by removing trees. One risk is initial higher water yields (moisture and run-off) reducing tree canopy and water uptake. Tree canopies intercept many raindrops that never hit the forest floor. These droplets are returned to the atmosphere through evapotranspiration. Tree removal can increase soil moisture due to lack of interception and water uptake (NRC 2008). Soils are then

exposed to higher and longer periods of moisture. Increased and longer soil moisture periods can impose higher risk of slumps and slides based on local soil characteristics. Slumps and slides can cause detrimental impacts to water quality due to increased sediment loads in drainages and streams. This risk would be quickly reduced with regeneration of understory species. Various practices during timber harvesting could reduce the erosion potential. Leaving woody debris on site following harvest operations is one such practice. The debris would protect the soil from splash erosion impacts and presents physical barriers to soil movement (USDA FS 2006b). Additionally, all clearcuts are proposed on lesser-sloped ground, which should reduce risk of slumps and slides.

Prolonged erosion can be a major negative effect. Not only does sediment contaminate water, the nutrients living in sediment can pose risks to water. Excessive nutrient and sediment run off can contribute to increases in eutrophication rates of streams and lakes. This flush of nutrients can cause harmful algae blooms within the watershed. Overload of nutrients are a common problem and are usually caused from agricultural practices such as row crops and pasture/rangelands (Bunch 2016). Because adequate BMPs can keep excessive soil erosion from being detrimental to water quality (Jones et al. 1997), both managed and unmanaged forests have long been associated with the highest water quality when compared to other land uses (Brown and Binkley 1994). The Pate Hollow Water Quality Study, which had similar soil types and topography, states that 10-15 percent of the watershed would need to be clearcut for any changes in water quality to be observable (Moss 1995). The Houston South Project proposes 401 acres of clearcut, 0.6 percent of the South Fork Salt Creek watershed. Best Management Practices (BMPs) are implemented for any harvesting activity on the Hoosier. These BMPs are monitored to check for efficiency in reducing erosion. When a system of BMPs are implemented, the loss of sediment and nutrients can be greatly reduced as a result of silvicultural activities (Wynn et al. 2000).

Although forest cover provides maximum run-off and erosion control benefits, steep slopes on much of the forested land exist in the South Fork Salt Creek watershed. These conditions encourage greater run-off, sediment and nutrient losses than otherwise observed on flatter slopes. Ground disturbing activities must be designed and implemented appropriately. There are adequate BMPs that can be used for this terrain (Jones et al 1997). It was found that there is a 96.5 percent effectiveness of BMPs on federal lands (McCoy and Sobecki 2017).

Harvesting causes different levels of impacts to soil and water resources based on the type of activity within the harvest unit. Landings, roads, and skid trails have had the most potential for detrimental soil disturbance. These areas are impacted due to longer term heavy equipment use during harvesting. Incorporating appropriate BMPs would mitigate these detrimental impacts.

Aust and Blinn (2004) synthesized research of forestry BMPs on the effects to water quality and productivity over a 20-year period in the Eastern United States. The results from the large amount of research indicate that BMPs that minimize soil and litter layer disturbance, facilitate rapid regeneration and control overland flow of water do

effectively minimize negative water quality effects of harvesting and site preparation. Most water quality problems associated with forest harvesting are actually problems caused by poorly designed and constructed roads and skid trails, inadequate closure of roads and skid trails, stream crossings, excessive exposure of bare soil, or lack of adequate Streamside Management Zones (SMZs) (Aust and Blinn, 2004).

The use of SMZs or riparian buffer zones in harvest operations can help protect biological communities that rely on riparian habitat. Maigret et al. (2014) found that when ephemeral streams are protected with SMZ regulations, declines in salamander abundances can be mitigated. Results from Semlitsch et al. (2008), strengthen recommendations to manage and harvest timber in small plots to allow forest dependent, pond breeding amphibians to shift habitat to increase survival and increase the potential for subsequent recolonization after succession. Their results also show that evacuation of pond breeding salamanders is reduced by the presence of high amounts of down wood and strengthens management recommendations to retain down wood on clearcuts. Sampling done by Hoosier biologists in ponds in or near clearcuts in the Jeffries timber sale in 2016 showed over 400 adult breeding salamanders in 4 minnow traps. The clearcut took place in 2014 and 2 years later showed little negative affect on the native salamander population.

Log landings are areas where logs are sorted and loaded for transportation. The intense use of these areas creates a risk to soil and water quality. Skid trails are also a risk to soil and water resources in the harvest unit. Skidders traverse the terrain hauling timber from the cut area to the landing area. Soil compaction is a potential risk which limits root growth for vegetation cover, accelerates surface erosion, and inhibits soils processes. Forest Plan guidance and design measures (Appendix A) would minimize these risks.

Although much of the terrain in Houston South is relatively steep, harvesting can be completed with Forest Plan guidance, BMPs and appropriate equipment. Tracked equipment is preferred on steep terrain because of its evenly distributed weight. This distribution gives these vehicles the ability to maneuver with less disturbance. Skid trails would generally be located on the stable high point of a ridge to ensure minimal soil disturbance.

The Forest Plan (USDA FS 2006a) has many management requirements that address soil disturbance and water quality risks that can be identified and used at the project level to reduce impacts. Design measures and BMPs are listed in Appendix A of this EA.

The Forest Plan contains provisions for timber harvesting near riparian areas. Permanent water bodies have a 100-foot buffer from any activity. Ephemeral streams require a minimum of 25-foot buffer and intermittent streams require a minimum of 50-foot buffer (USDA FS 2006a). Waterholes or small ponds up to a half acre with slopes no more than 5 percent, have a 25-foot buffer. Soil-disturbing activities within designated riparian corridors require effective erosion control. Erosion control measures such as straw bales in ditch lines and small drainages, berms in road embankments during construction, diversion ditches, slash and unmerchantable logs across slopes and trails, check dams in

ditch lines, sediment detention basins, and sediment fences (USDA FS 2006a) would be implemented.

Three AOPs are proposed within the project boundary. Approximately four acres would be disturbed during new crossing construction. However, once completed, the natural flow regime would promote less excessive bank erosion and help mitigate channel incision.

Watershed restoration techniques in headwater streams for erosion control would occur to repair head cut and gullying that is occurring in the project area. Watershed restoration would have minimal disturbance due to the small sections of stream rehabilitated.

The Pate Hollow Study documents that water quality is not detrimentally affected by harvests in similar geological, topographic and soils regimes as Houston South (Moss 1995). Managed and unmanaged forests have long been associated with highest water quality when compared to other land uses (Brown and Binkley 1994). Long-term water quality within the Houston South Project should remain the same or be slightly improved based on initial disturbances and long-term improvements if Forest Plan standards and guidelines, BMPs, and mitigation practices are followed.

The Forest Service follows BMP monitoring guidelines to protect water quality using the National Best Management Practices for Water Quality Management on National Forest System Lands Technical Guide (USDA FS 2012). The National BMP Program consists of four main components: (1) a set of National Core BMPs, (2) a set of standardized monitoring protocols to evaluate implementation and effectiveness of those BMPs, (3) a data management and reporting structure, and (4) corresponding national direction (USDA, 2012). All management activities of other resources are to be designed to minimize short-term impacts on the soil and water resources and maintain or enhance long-term productivity, water quantity, and water quality. BMP monitoring focuses around projects within the aquatic management zones. An Aquatic Management Zone (AMZ) is a designated area near or around a stream channel and other waterbodies. AMZ delineation is site specific and may encompass floodplain and riparian areas (USDA 2012). The AMZ is monitored for implementation and effectiveness of BMPs. Chemical treatments, road reconstruction and construction, skid trail use, pond and wetland construction/ restoration, stream bank re-stabilization, facility use, prescribed burning, recreational trails and facilities are all addressed within the National BMP monitoring protocol. All these activities would be monitored within the Houston South Project.

Since the South Fork Salt Creek watershed borders the municipal Lake Monroe-Salt Creek watershed, four sites are currently being monitored for stage, discharge and turbidity. The sites are: South Fork Salt Creek at Kurtz, South Fork Salt Creek near Maumee, Negro Creek and Callahan Branch.

Background information on these sites is being collected to assess current water quality in relation to sediment. Soil disturbance would be the main risk to the watershed if BMPs fail or insufficient BMPs are used. Along with BMP inspections, turbidity would also be

an indicator of water quality. Turbidity is the measure of clarity of water. Material that causes turbidity includes clay, silt, inorganic and organic matter, algae, and dissolved colored organic compounds. Turbidity readings are commonly used to indicate increased sedimentation during soil disturbing projects. Baseline turbidity readings have been collected in association with discharges since stage (water levels) cannot be directly associated with turbidity due to backwater effects on South Fork Salt Creek from Lake Monroe. Backwater affect is pooling of accumulated water in a stream channel indicating high flow stages, but less discharge associated with it. A non-backwater affect at the same location may have the same high flow stage but a greater discharge. There is not a linear relationship between turbidity and discharge, but higher turbidity readings are typically justified by higher flows. Baseline information shows pre-harvest and pre-burn turbidity conditions driven by natural erosion, private land use, and seasonal plant and algae growth. Turbidity monitoring would be ongoing throughout the life of the Houston South Project to ensure BMPs are effective. Higher turbidity can be associated with lower discharges depending on land use disturbances (agriculture, timber harvest, etc.) within the area. If turbidity levels are monitored higher than control background information, further investigation and monitoring would be deployed to ensure BMPs are effective within the harvest unit.

No Action

With the No Action Alternative, no management-related changes in soil productivity would occur. Current runoff and erosion patterns would be expected to remain the same, decreasing water quality and available aquatic habitat over time. This alternative makes no plans to take action on roads and trails that are in poor condition and likely contributing sediment to streams. The three aquatic organism passages that are proposed to widen channel flows through crossings which could reduce channel incision, erosion and sedimentation would not be constructed. The restoration of head-cut streams, which could reduce sedimentation of streams, would not occur.

Cumulative Effects for Issues 2-4

Ongoing and past activities on private land include timber harvesting, grazing, agriculture activities, and other minor residential disturbances, all of which can impair soil and water quality. Approximately 1,153 acres of agricultural land exists within the South Fork Salt Creek watershed floodplain.

Historically, best management practices may not have been applied commonly on private lands. Private land owners have been encouraged over the last decades to adopt soil and water conservation practices. However, even when such practices are employed during an activity, consistent long-term maintenance practices to control erosion and sedimentation from disturbances are less likely to have been (or be) implemented for many private land uses. Agriculture, timbering, residential development and associated activities are expected to continue in the future.



Figure 8: Tractor with South Fork Salt Creek Flood debris

Additional new soil disturbances have been occurring on private land, including recreational use of off-road vehicles. Future actions will likely add to historic soil disturbances, resulting in more soil and water quality degradation.

Furthermore, since private lands have typically been less regulated and are expected to remain less regulated in the future, soil-

disturbing activities that negatively affect soil and water quality will likely persist.

Issue 5: Concern that closing trails during periods of timber management could have negative impacts to recreationists

Indicators:

- Miles of affected trail in or adjacent to areas proposed for treatment
- Duration of trail closures

For Issue 5: Analysis Area:

The spatial boundary used to evaluate direct, indirect, and cumulative effects is the Houston South Vegetation and Restoration Project boundary. The timeframe of consideration for effects to recreation is approximately 12-15 years for harvest activities and up to 20 years intermittently for post-harvest burning activities.

Direct and Indirect Effects for Issue 5

Proposed Action

The proposed Houston South Vegetation Management and Restoration Project would have both positive and negative impacts to recreation trail users, and other modes of recreation; depending on the perspective of the observer, and time of use. Approximately 26 miles of the Hickory Ridge trail system and the 3.5 miles of the Fork Ridge trail are within the project area. Trail users would be affected by approximately 14.5 miles of temporary trail closures during the time period of timber sales, intermittently, over 12 to 15 years. Approximately 11.5 miles of trails could be affected by silvicultural treatments and an additional three miles of trails could be affected by skidding and hauling timber. Not all 14.5 miles would be closed at the same time.

All trails within the project boundary would not be impacted at once, and some trails segments and sections may not be impacted at all. Silvicultural treatments affecting trail

corridors would include approximately 9.5 miles of the Hickory Ridge trail system and two miles of the Fork Ridge trail. While harvesting is being actively implemented these trails would be signed as “closed”. Timber sales typically last one to three years, and trail segments affected would only be closed during active removal within the timeframe.

Table 4: Approximate miles of trail affected by silvicultural treatments

Silvicultural Treatment	Trail Miles Affected
Clearcut	2 miles
Shelterwood	1.5 miles
Selection	0.5 miles
Hardwood Thinning	5.5 miles
Midstory Removal	1.5 miles
Crop Tree release	0.5 miles
Totals	11.5 miles

Some trail segments would be developed into temporary roads to effectively cut and remove timber (USDA FS 2018). There are 8.7 miles of existing system roads that coincide with trails in the project area, of which approximately 2 miles would be maintained or reconstructed and approximately 3 miles of the trail would be upgraded to system or temporary roads by new road construction. Additionally, approximately 1 mile of existing road with trail attached would be decommissioned and returned to trail only status. Any road reconstruction or construction that occurs on an existing designated trail



Figure 9: Hickory Ridge Trail #11 (May 2019)

would be rehabilitated per design measures and returned to its original condition (or improved condition) upon road use expiration. It may be determined that the location of the temporary road that is not a designated trail is a more sustainable location than the nearby existing trail location, thus trails may be relocated to where the road would be constructed. If a trail segment is relocated to a more sustainable location, the pre-existing trail would be obliterated and closed. Any newly located trail would meet Forest Service trail standards. Long term trail conditions would improve in these cases, thus improving the recreation experience. Because the location of an existing designated trail may change slightly the overall trail mileage may increase or decrease up to 2 miles within the project area.

Trails within the project boundary may also be used for skidding timber. Trails impacted by skid use would be returned to their pre-existing state by the contractor if determined that the trail is in the best location from a

sustainability standpoint. Trails would follow Forest Service design measures for rehabilitation after use for silvicultural treatments.

Trail re-routes may occur on trails that are in riparian areas or in poor locations including trail #15, #20, and the conjoining system area of #11, #12, #3, and #13, regardless of project impacts (figure 9). Additionally, a short spur trail (approximately 0.2 mile) with limited parking, would be added as a connector trail to trail #15. A permanent trail closure would occur on trail #20 starting at County Road 925N to the junction of trail #18, due to poor trail condition and low use. Total mileage of the proposed trail closure segment is approximately 0.5 mile. Trail mileage would not greatly change but may increase or decrease up to two miles overall depending on the best sustainable locations of trails affected. Because contractor work would vary, additional mitigation measures may be determined after treatments to restore the trail corridor, including determining if a re-route is needed.

Beginning in 2020, silvicultural treatments would be based on identified treatment units, affecting approximately 11.5 miles of trail. This disturbance would be distributed throughout the implementation period of 10-15 years and not all at once. Approximately three miles of additional trail would be impacted by skidding and hauling timber. Recreation impacts would be considered in the scheduling of sale units. Treatment units would be staggered, and adjoining units would not be impacted at the same time. Treatments may occur in one area, and then followed by another area within the project boundary but not directly next to the previously treated unit. Staggering of units would alleviate some impacts to recreation. The least amount of trail closure needed to ensure safety and project success would be applied, but only during active sales and active prescribed burning.

Although silvicultural treatments and prescribed burns would negatively affect trail use and other recreational activities in the project area, the long-term benefit of restoring early successional habitat and the regeneration of oak and hickory trees substantiates the need for short term impacts to recreation. Similar recreation opportunities are offered nearby on other Hickory Ridge trails outside of the project area (approximately 25 miles of trails), the Nebo Ridge and D trail (approximately seven miles of trails), as well as further south on the Forest at the Shirley Creek trail system (nearly 20 miles of trails). Additional recreation trails are also available nearby in the Charles C. Deam Wilderness. Overall, the Hoosier National Forest has approximately 260 miles of recreation trails (USDA FS 2006a).

Signage of educational and interpretive value may be installed along affected trails to better inform the public and trail users of forest management techniques.

No Action

Under the No Action Alternative, no vegetation treatments would be implemented, no road work would occur, and there would be no effect to users of the Hickory Ridge and Fork Ridge trail systems and associated roadways in the short or long term. Trail maintenance and trail use would continue uninterrupted except for strong wind events

resulting in down trees. In those cases, the trail would be temporarily closed for safety concerns while it is cut out. The non-native pine trees, particularly along the trail, would continue to be susceptible to disease and die off and be prone to blow down during wind events. An increase of hazard trees would be likely as trees continue to age and mature along trail and road corridors.

Cumulative Effects for Issue 5

The geographic boundary for cumulative effects to visuals and recreation is the proposed Houston South Vegetation and Restoration Project boundary. No additional cumulative effects to recreation resources are anticipated as there are no other past, present, or future recreation actions predicted to contribute aggregated effects. The time period is from the beginning of the proposed project, 2020 through 2040 when the Houston South project treatments would be complete, bearing in mind most silvicultural treatments would be complete within 12-15 years, and prescribed burning effects are short-term and intermittent, within the 20-year window.

Issue 6: Concern that prescribed burning could have negative impacts on recreational opportunities

Indicators:

- Miles of affected trail in or adjacent to areas proposed for treatment
- Miles of roads in or adjacent to areas proposed for treatment

For Issue 6: Analysis Area:

The spatial boundary used to evaluate direct, indirect, and cumulative impacts is the Houston South Vegetation and Restoration Project boundary. The timeframe of consideration for effects to recreation from prescribed burning is 20 years, however burn units typically impact recreation for only a day or two, with trail closures occurring up to five days depending on unit conditions following the burn.

Direct and Indirect Effects for Issue 6

Proposed Action

Approximately 26 miles of trails of the Hickory Ridge trail system and 3.5 miles of the Fork Ridge trail are within the project boundary and may be used for prescribed burning fire lines and access. Of the 16.4 miles of FS system roads within the project area, currently 1.2 miles are open to public motorized vehicle use. Proposed prescribed fire activities and associated road and trail closures would create some inconvenience for users and disruptions to recreational activities. However, any disruption would be temporary in nature (approximately five days), and closures would only be needed during the active time of the burn. Burns would be scheduled by units, and the entire project area would not be impacted at the same time, but instead spread out over several years. Annual acres burned for this project would average approximately 1,500 acres. Trails within a burn unit would be signed “closed” during the burn, with public notice via social media outlets and press releases.

During prescribed burning, trail users would be displaced for a short time because of trail closures. Similar recreation opportunities are offered nearby on other Hickory Ridge trails outside of the project area (approximately 25 miles of trails), the Nebo Ridge and D trail (approximately seven miles of trails), as well as further south on the Forest at the Shirley Creek trail system (nearly 20 miles of trails). Additional recreation trails are also available nearby in the Charles C. Deam Wilderness.

No Action

Under the No Action Alternative, no vegetation treatments would be implemented, no road work would occur, no prescribed burning would occur and there would be no direct effect to recreational activities. Habitat diversity would not be increased, and oak and hickory species would continue to decline, which may impact recreationist who seek a diversity in wildlife.

Cumulative Effects

No additional cumulative effects to recreation resources are anticipated as there are no other past, present, or future actions predicted to contribute aggregated effects. The time period is from the beginning of the proposed project, 2020 through 2040 when the Houston South project treatments would be complete, bearing in mind prescribed burning effects are short-term and intermittent, within the 20-year window.

Issue 7: Concern that proposed harvest treatments and prescribed fire treatments could degrade the visual quality along trail corridors**Indicators:**

- Visual Quality Objectives

For Issue 7: Analysis Area:

The spatial boundary used to evaluate direct, indirect, and cumulative impacts is the Houston South Vegetation and Restoration Project boundary. The timeframe of consideration for effects to visuals is twenty years, to allow for substantial rejuvenation of grasses, brush, and other vegetation.

Direct and Indirect Effects for Issue 7**Proposed Action**

The proposed Houston South Vegetation Management Restoration Project would have both positive and negative effects on the visual quality of the viewing area along trails and roads within the project boundary, depending on the perspective of the observer and time of use. Silvicultural treatments would change the visual character of the area, particularly within the first several years. Forest visitors using trails in the project area and travelers along associated roads bordering the project would see a landscape with a



Figure 10: Two Lakes Trail in 2014 harvest unit (2019 Photo)

more open appearance in areas, rather than stands of trees throughout. Treatments would vary; thus, the level of visible impact would also vary. A mosaic of forest conditions would be visible in the treated areas, providing diverse forest age classes and habitat types, thus increasing the diversity of viewable wildlife and other visual qualities. In several years, the stands would appear more natural as regeneration proceeds. The visual evidence of woody debris and stumps would diminish as new vegetation grows. Portions of the treatment areas would appear as a heavily disturbed landscape at first but would eventually blend in during later growing seasons. Although the current landscape would be altered in treatment areas, the proposed activities would promote a landscape dominated by hardwoods, create early successional habitat, and restore dry hardwood forest ecosystems that have not

experienced periodic disturbance due to fire or other naturally occurring events (USDA FS 2018).

Approximately 11.5 miles of the identified trail systems within the project area would be affected by silvicultural treatments. An additional three miles of trails could be affected by skidding and hauling timber.

In addition to silvicultural treatments, prescribed burning would take place within the Houston South Vegetation and Restoration Project boundary, having short term negative effects on visual quality. Techniques applied are generally considered “light”, or low to moderate intensity burning. In most instances, burned areas are relatively indistinguishable from adjacent unburned areas unless the burned area is part of a restoration effort (Kolaks 2011). Prescribed burning would occur within control lines and smoke would be visible during the burns and within a short window of time following the burn. Any burn scars on trees within site distance of the Hickory Ridge and Fork Ridge trail systems and associated roadways would have a short-term negative effect on visual quality. Soon, the positive visual effects of burning would dominate by enhancing aesthetics by maintaining open stands, increasing numbers of flowering annuals and biennials, increasing herbaceous cover and maintaining open spaces such as vistas. In terms of silviculture, fire promotes the release of existing oak reproduction, thus supporting the purpose and need of the proposed project (Kolaks 2011).

The visual impact of silvicultural treatments and prescribed burning would not be occurring all at once for the entire identified project area. Silvicultural treatments and burns would be scheduled in units. Silvicultural treatment and associated sales within an

identified unit typically occur for 1 to 3 years. Prescribed burns typically take a day or two per unit, with trail closures occurring up to five days depending on conditions. All debris resulting from vegetative management and prescribed fire use would be treated to maintain the visual foreground along frequently traveled roads, trails, and streams to meet visual quality objectives defined in the Forest Plan (USDA FS 2006a).

No Action

Under the No Action Alternative, no vegetation treatments would be implemented, no road work would occur, and there would be no effect to users of the Hickory Ridge and Fork Ridge trail systems. Vegetation would continue to grow and die naturally, thus visuals would be affected by natural conditions. Conversely, the non-native pine trees, particularly along the trail, would continue to be susceptible to disease and die off and be prone to blow down during wind events. Habitat diversity would not be increased, and oak and hickory species would continue to decline, which may impact the visual enjoyment of some, especially for users who are seeking a diversity of wildlife.

Cumulative Effects for Issue 7

The geographic boundary for cumulative effects to recreation is the proposed Houston South Vegetation and Restoration Project boundary. No additional cumulative effects to visual quality are anticipated as there are no other past, present, or future actions predicted to contribute aggregated effects.

Issue 8: Concern that vegetation management and the use of herbicide treatment could have negative effects to the Salt Creek watershed

Indicator:

- Chemical contaminants from herbicides

For Issue 8: Analysis Area:

The spatial boundary used to evaluate direct, indirect effects is the project boundary. The spatial boundary used to evaluate cumulative effects is the South Fork Salt Creek watershed. The timeframe of consideration for effects of herbicide treatment is 12-15 years because silvicultural treatments would be complete by this period.

Direct and Indirect Effects for Issue 8

Proposed Action

Selective herbicide applications are proposed for site preparation and stand improvement activities on 1,970 acres. Forestry herbicides are a versatile, cost-effective tool that can be used in a variety of ways to help manage forest vegetation (Kochenderfer et al. 2012). Table 4 shows average stems per acre to be treated in each area proposed for herbicide use.

Table 5: Proposed areas for selective herbicide treatments and average stems per acre to be treated with herbicide

Treatment Area	Acres	Objective	Average stems per acre to be treated
Clearcut	401	Site preparation for natural regeneration; post-harvest	219
Shelterwood	703	Site preparation for oak-hickory regeneration; pre- and/or post-harvest	238
Selection	462	Site preparation for natural regeneration in group selection areas; post-harvest	179
Midstory Removal	234	Site preparation for oak-hickory regeneration	226
Crop Tree Release	170	Release of crop trees	80
Total	1,970		

Herbicide use for stand improvement and site prep activities typically requires a single application to attain the desired effects. Herbicide would be applied specifically to the trunks and stumps of targeted woody vegetation resulting in a relatively small area of application with little to no herbicide contacting the soil. The maximum amount of herbicide used in a given treatment should remain well below the maximum forestry use rate per year as identified on the manufacturer's label. For example, when using Arsenal® (imazapyr) for stem injection treatments (hack and squirt), the maximum use rate for forestry treatments is 96 ounces/acre/year. Assuming three-inch-wide hacks and an average tree diameter at breast height (dbh) of six inches, 705 stems could be treated with a concentrate treatment or 9,600 stems could be treated with a dilute treatment. The average number of stems per acre to be treated in this project (Table 4) are considerably lower than the number that could be treated without exceeding the maximum use rate of the herbicide.

Numerous studies have demonstrated that modern herbicides can be safely applied in forests. Forestry herbicides inhibit biochemical pathways that are specific to plants. Commonly used and recommended forestry herbicides are very low in animal toxicity and do not bioaccumulate. Because of their low toxicity and minimal environmental hazards, most herbicides used in forestry operations are classified as "non-restricted use" meaning they are available to the general public and no license is required for landowners to buy them and apply them on their own land. Research has shown that herbicides used in forestry biodegrade relatively fast after application (Kochenderfer et al. 2012). See Tables 7 and 8 for herbicide risk characterizations for wildlife and the environment.

Proposed herbicides for this project would include a subset of those identified for use under previous decisions in which a Finding of No Significant Impact (FONSI) was prepared (USDA FS 2009a, USDA FS 2018). A list of proposed herbicides and targeted use can be found in Table 6.

Table 6: Proposed herbicides and targeted use for undesirable native species

Chemical Name	Examples of Trade Names	Targeted Use	Examples of Native Trees to be Targeted	Risk Assessment
Glyphosate	Accord®	Cut-Stump Treatment	Sugar maple, red maple, American beech	SERA 2011a
Imazapyr	Arsenal®	Stem Injection	Sugar maple, red maple, American beech	SERA 2011b
Triclopyr	Garlon®3A Garlon®4	Cut-Stump and/or Basal-Spray Treatment	Sugar maple, red maple, American beech	SERA 2011c

Table 7: Herbicide risk characterization for wildlife

Herbicide Risk Characterizations for Wildlife	
Glyphosate (SERA 2011a)	
Mammals, Birds, and Terrestrial Invertebrates	Effects to birds, mammals, fish, and invertebrates are minimal. Based on the typical application rate of 2 lbs. a.e./acre, none of the hazard quotients for acute or chronic scenarios reach a level of concern even at the upper ranges of exposure. For the application of 7lbs. a.e./acre, there is some level of concern with direct spray of honey bees, for large mammals consuming contaminated vegetation, and smallbirds consuming contaminated insects. These concerns are based on conservative dosing studies and environmental conditions that are not likely to occur in the field. The studies showing adverse effects are using formulations that are not legal, or available, in the U.S.
Aquatic Organisms	Some formulations of glyphosate are much more acutely toxic to fish and aquatic invertebrates than technical grade glyphosate or other formulations of glyphosate. This difference in acute toxicity among formulations appears to be due largely to the use of surfactants that are toxic to fish and invertebrates.
Soil Microorganisms	Transient decreases in the population of soil fungi and bacteria may occur in the field after the application of glyphosate at application rates that are substantially less than those used in Forest Service programs. However, several field studies have noted an increase rather than decrease in soil microorganisms or microbial activity, including populations of fungal plant pathogens, in soil after glyphosate exposures. While the mechanism of this apparent enhancement is unclear, it is plausible that glyphosate treatment resulted in an increase in the population of microorganisms in soil because glyphosate was used as a carbon source and/or treatment with glyphosate resulting in increased nutrients for microorganisms in the soil secondary to damage to plants.
Imazapyr (SERA 2011b)	
Mammals, Birds, and	In terrestrial animals and birds, imazapyr is practically non-toxic. Adverse effects in terrestrial or aquatic animals do not appear to be likely. The

Herbicide Risk Characterizations for Wildlife	
Terrestrial Invertebrates	weight of evidence suggests that no adverse effects in mammals, birds, fish, and terrestrial or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.45 lb/acre or the maximum application rate of 1.25 lb/acre. Although imazapyr has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging non-target organisms, the available data are sufficient to assert that no adverse effects on animals are anticipated based on the information that is available.
Aquatic Organisms	Imazapyr does not appear to be very toxic to aquatic fish or invertebrates.
Soil Microorganisms	Imazapyr is relatively non-toxic to soil microorganisms, aquatic invertebrates, and fish. Imazapyr is not expected to bioaccumulate in the food chain.
Triclopyr (SERA 2011c)	
Mammals, Birds, and Terrestrial Invertebrates	Contaminated vegetation is the primary concern in the use of triclopyr and that high application rates will exceed the level of concern for both birds and mammals in longer exposure scenarios.
Aquatic Organisms	An application rate of 1 lb/acre, acute and chronic risks to aquatic animals, fish or invertebrates, as well as risk to aquatic plants are low with use of the salt form of triclopyr. At the highest application considered in this risk assessment, 9 lbs a.e./acre, the risks to aquatic animals remain substantially below a level of concern. The ester form of triclopyr is projected to be somewhat more hazardous when used near bodies of water where runoff to open water may occur. Applications of the ester formulation can reach levels of concern at 3 lb. a.e./ac for fish and amphibians, 1.5 lb. q.e/ac for aquatic insects and 1.0 lb. a.e./ac for aquatic plants.
Soil Microorganisms	The potential for substantial effects on soil microorganisms appears to be low. An application rate of 1 lb/acre is estimated to result in longer term soil concentrations that range from 0.24ppm to 2.2 ppm – which are a factor of 3 below chronic levels for earthworms (6.0ppm). Using the laboratory studies to characterize risk, transient inhibition in the growth of some bacteria or fungi might be expected. This could result in a shift in the population structure of microbial soil communities but substantial impacts on soil – i.e., gross changes in capacity of soil to support vegetation – do not seem plausible. This is consistent with the field experience in the use of triclopyr to manage vegetation.

Table 8: Herbicide risk characterization for the environment

Herbicide Risk Characterization for the Environment	
Glyphosate (SERA 2011a)	
Solubility	Glyphosate is strongly adsorbed to soil particles, which prevents it from excessive leaching or from being taken-up from the soil by non-target plants. Glyphosate is degraded primarily by microbial metabolism, but strong adsorption to soil can inhibit microbial metabolism and slow degradation. Photo- and chemical degradation are not significant in the dissipation of glyphosate from soils.
Half Life	For glyphosate, the half-life ranges from several weeks to years, but averages two months. In water, glyphosate is rapidly dissipated through adsorption to suspended and bottom sediments, and has a half-life of 12 days to 10 weeks. Foliar half life averages 7-10 days.
Toxicity	By itself, glyphosate has relatively low toxicity to birds, mammals, and fish, and at least one formulation (Rodeo®) is registered for aquatic use. Some surfactants that are included in some formulations of glyphosate are highly toxic to aquatic organisms, and these formulations are not registered for aquatic use.
Imazapyr (SERA 2011b)	
Solubility	Imazapyr is a weak acid herbicide and environmental pH will determine its chemical structure, which in turn determines its environmental persistence and mobility. Below pH5, the adsorption capacity of imazapyr increases which limits its movement in soil. Above pH 5, greater concentrations of imazapyr become negatively charged, fail to bind tightly with soils, and remain available for plant uptake and/or microbial breakdown. Imazapyr has not been reported in water runoff despite its potential mobility.
Half Life	The half-life of imazapyr in soil ranges from one to five months, and in aqueous solutions, imazapyr may undergo photodegradation with a half-life of two days. Foliar half life ranges from 15-27 days.
Toxicity	Imazapyr has low toxicity to fish, yet algae and submersed vegetation are not affected. Imazapyr is not highly toxic to mammals or birds. This herbicide is excreted from mammalian systems rapidly with no bioaccumulation in tissues.
Triclopyr (SERA 2011c)	
Solubility	Triclopyr is relatively persistent and has only moderate rates of adsorption to soil particles, therefore, offsite movement through surface or sub-surface runoff is a possibility. In water, the salt formulation is soluble, and with adequate sunlight, may degrade in several hours. The ester is not water soluble and can take significantly longer to degrade. Because it can bind with the organic fraction of the water column, it can be transported to the sediments.
Half Life	Degradation occurs primarily through microbial metabolism in soils, but photolysis and hydrolysis can be important as well. The average half-life of triclopyr acid in soils is 30 days. Foliar half life is 15 days.

Toxicity	Triclopyr can cause eye damage (corrosive/irreversible) if splashed into the eyes during application. Both the salt and ester formulations are relatively non-toxic to terrestrial vertebrates and invertebrates. However, the ester formulation can be extremely toxic to fish and aquatic invertebrates.
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No Action

With no action, no additional herbicides would be applied to the project area. There would be no additional direct or indirect effects related to herbicide use from implementing silvicultural treatments.

Cumulative Effects for Issue 8

Alternative A proposes select herbicides to treat native undesirable vegetation. Proposed herbicides were selected largely for their low toxicity to humans and the environment. Foreseeable future activities in the project area include possible treatment of non-native invasive vegetation with the same herbicides proposed in this project. It is possible that these treatments could overlap spatially, but precautions would be taken to ensure they do not overlap temporally. This will ensure application rates do not exceed those recommended on the manufacturers' labels, therefore there are no cumulative effects from overlapping herbicide applications.

Within the project boundary there are an estimated 2,600 acres of agricultural land on private ground. It is safe to assume that herbicides are used on much of this land either to spot-treat pastures or to treat entire fields, sometimes multiple times each year. These applications are not considered because it is unlikely that herbicides applied on NFS lands would translocate sufficiently to combine with them. Nor would National Forest applications involve the treatment of food crops.

Issue 9: Concern that prescribed burning could harm or displace wildlife

Indicator:

- Habitat condition

For Issue 9: Analysis Area:

The spatial boundary used to evaluate direct and indirect effects is based on the Ecological Classification System and primary habitat association. The project area is within the Brown County Hills Subsection (222Em). Because bat species that can forage over longer distances, a 5-mile buffer was established for the cumulative effects geographical boundary. The temporal consideration for cumulative effects is 20 years, as prescribed fire treatments would likely be completed in this timeframe.

Direct and Indirect Effects for Issue 9

Proposed Action

As maturing oaks and hickories age and die, they are being replaced by trees such as maple and beech. Oak-hickory ecosystems need management activities to regenerate due to severe competition by less desirable species. Although prescribed burning can have an immediate and direct negative impact on wildlife, these effects are usually short-lived. The lasting effects of keeping oak in the ecosystem outweigh the short-term negative effects. For example, at least 534 native species of lepidoptera (e.g. moths and butterflies) consume oak leaves and inhabit the furrowed bark of oak trees, not found on smooth barked maple and beech, that provides shelter from predators (Brose et al. 2014). Stands of oak trees support a significantly higher abundance and species richness of birds, a main predator of insects, during all seasons as compared to red maple stands. Additionally, Brose et al. (2014) predicts the conversion of oak forest to maple forest to have a severe impact on the bird communities of the eastern United States. Furthermore, more than 100 vertebrate species regularly consume acorns (Brose et al. 2014).

A lack of fire in the area is also causing oak-hickory seedlings to be suppressed by a shade-tolerant mid-story species. Reintroducing fire would promote regeneration and maintenance of mast producing oak and hickory. Prescribed burn treatments are proposed to enhance habitat conditions to promote oak and hickory regeneration for mast in Management Area (MA) 2.8 and improve habitat for wildlife and plant species in MA 2.4 and 6.4.

Regional Forester Sensitive Species (RFSS)

A biological evaluation (BE) was prepared to ensure that decisions regarding land management are made with recent scientific information regarding RFSS and the habitats they may occupy on the Hoosier National Forest. The effects related to prescribed fire are presented here, the complete BE can be found in the Houston South Vegetation Management and Restoration Project Record.

Review of the Indiana Heritage Database does indicate presence of Regional Forester Sensitive Species (RFSS) within the project area and the surrounding vicinity (IDNR 2015, 2012). However, during site-specific surveys, no RFSS were located. Additionally, there are no known caves located in the project area.

There are currently 141 RFSS for the Hoosier National Forest. These sensitive species with known occurrences on the Forest inhabit a diverse array of habitat. Animal species include four mammals, six birds, six fish, two amphibians, one reptile, two mollusks, 47 terrestrial invertebrates and 37 karst invertebrates. There are 34 vascular plants and two non-vascular plants on the RFSS list.

The RFSS occur in 10 community types and habitat, plus those wide-ranging species that use diverse habitats. Mesic forests, dry forest types, wetlands, small streams, ponds, open lands plus wide-ranging species that use diverse habitats occur in the project area. Habitats that do not occur within the project area include cliff, barrens and larger rivers.

Therefore, the proposed project would have no effect on populations of sensitive species associated with cliff, barrens, and larger river habitat.

Mammals

The Allegheny woodrat (*Neotoma magister*) is not found on the Brownstown Ranger District and has no habitat inside the project area or cumulative effects area. Due to the lack of suitable habitat (cliff communities), the species is considered not present and there would be no effect to this species or its habitat.

The little brown myotis (*Myotis lucifugus*), tricolored myotis (*Perimyotis subflavus*) and the evening bat (*Nycticeius humeralis*) were the only mammal species, on the current RFSS list that prefer the type of habitat found in the project area. All three bat species on the RFSS list are wide-ranging and could use this area for feeding, roosting, and corridors. All three bats are considered present and were located in the Hoosier National Forest during the 2010 mist-net surveys (McClanahan 2010) or current acoustic monitoring.

The little brown and tricolored bat can be found in a cave inside the cumulative effects boundary, although in low numbers. White-nose syndrome (WNS) is known to occur in this species and has heavily affected Indiana. Large declines have been noted during forest hibernacula surveys (Harriss) and this species is now considered rare.

Project activities could negatively impact these species concerning roosting, staging/swarming and summer habitat. However, growing season burning would be minimal and not likely during the periods when young are born. Removal of hazard trees for fire line preparation may indirectly affect bat species by removing potential roost trees. Crews would remove trees for fire line during the bat's inactive period to avoid any direct effects.

The proposed project would have short-term effects with long-term benefits for these species regarding travel corridors and foraging. Design criteria, vernal pools and existing cover habitat adjacent to the project area would benefit these species, but negative impacts could occur. Therefore, this project may impact the little brown and tricolored bat.

Since both bat species have rare occurrences on the landscape, the availability of existing cover habitat adjacent to the project area and rarity of growing season burns, project activities should not contribute towards federal listing or result in reduced viability of a population or species.

Evening bats have not been located in caves within the cumulative effects area. White Nose Syndrome is not known to directly impact this species. No documented sightings have occurred for the evening bat inside the project area or across the forest with recent mist net surveys (McClanahan 2014, York-Harris 2016). However, acoustical monitoring has found evening bats in the Pleasant Run unit along road corridors and on ridge tops.

The evening bat, though wide-ranging, appears to be most closely associated with mature river bottom habitats where it forms colonies within tree cavities or hollows (Whitaker and Gummer 2003). It is possible that these bats may use other habitat types and foraging areas based on observations while conducting acoustical surveys.

In Indiana, the evening bat has been ranked critically imperiled because of extreme rarity due to very few populations, very steep declines, or other factors making it especially vulnerable to extirpation from the state. Globally they are listed as secure. Locally on the forest, this species has appeared abundant during acoustical surveys.

Project activities may impact this species. Since the evening bat is considered nationally secure and the availability of existing cover habitat adjacent to the project area, project activities would not contribute towards federal listing or result in reduced viability of a population or species.

Vernal pools are a valuable water source for bat species and provides a forage area for insects as well. Sensitive bat species have been captured in a vernal pool complex on the Pleasant Run Unit in 2010 along with other threatened and endangered bat species. Proposed installation of vernal pools at some decommissioned road sites would create a beneficial effect for all bat species.

Birds

The Henslow's sparrow (*Ammodramus henslowii*), ruffed grouse (*Bonasa umbellus*), cerulean warbler (*Dendroica cerulean*), migrant loggerhead shrike (*Lanius ludovicianus migrans*), American woodcock (*Scolopax minor*) and barn owl (*Tyto alba*) were analyzed for this project as habitat types existing in the project area and cumulative effects area. Review of the Indiana Heritage Database indicated species on the RFSS list occur within the project area (IDNR 2012, 2015). Breeding bird survey data was also used for the analysis.

There were 14,280 observations of 84 bird species from 2001 to 2017 (9 years of data) within the project area. The top six species were red-eyed vireo (*Vireo olivaceus*), eastern wood-pewee (*Contopus virens*), Acadian flycatcher (*Empidonax virens*), worm-eating warbler (*Helmitheros vermivorum*) and wood thrush (*Hylocichla mustelina*). The brown-headed cowbird (*Molothrus ater*) was seventh, but there was a drop with 168 fewer observations (approximately 22% less) (Dunning, Riegel 2017). The Henslow's sparrow, cerulean warbler, loggerhead shrike and barn owl are listed as state endangered in Indiana. The woodcock and grouse are listed as species of special concern for Indiana (IDNR 2018).

Wildlife openings do exist in and near the project area but are too small to support Henslow's sparrow. A larger early successional area, greater than 75 acres, does exist inside the cumulative effects boundary. This area is approximately three miles away from the project area and does contain Henslow's sparrow. With proper timing and return

intervals, prescribed burns should have no known negative effects on habitat for this species.

Pre and post-prescribed burn monitoring would be key to determine effects needed and vegetative structure of the area. With the Forest Plan standards and guidelines in place, along with design criteria, the project should have a beneficial impact for the Henslow's sparrow, both short and long-term.

Ruffed grouse are currently thought to exist in 10-13 of the 43 Indiana counties occupied in 1983. Prospects for population recovery are dismal given the continual advancement of forest succession and population levels have likely dropped below "minimal viable population levels" within most of the current grouse range in Indiana. Ruffed grouse appear destined for extirpation unless significant intervention (e.g., extensive timber harvests of sufficient intensity) or sizable natural disturbances occur across the forested landscape in southcentral Indiana to create a large continuum of early successional forest habitats (Backs 2018).

A ruffed grouse survey route runs through the northwest corner of the project area and continues west through the cumulative effects area. Breeding population indices (males heard drumming/stop) have been estimated on the Forest since 1979. The last time a grouse was indicated during the survey was in 2012. Single grouse have been seen on occasion inside the Fork Ridge burn unit in 2012 and along the north end of the project area in 2016.

No male ruffed grouse were heard drumming on 14 roadside routes during the 2018 spring survey. This was the sixth consecutive year that no grouse were heard, with only one heard in the last seven years (Backs 2018).

Proposed timber harvest and prescribed fire would benefit this species and would provide the habitat that this species greatly needs. Short-term impacts of temporary displacement could occur if the species is present. However, without the proposed treatments, the grouse could be negatively impacted through lack of management.

The cerulean warbler prefers large tract of mature forest. It is considered present even though no sightings have been recorded. Cerulean warblers, a species of particular management concern, were not detected in the 2017 breeding bird survey, continuing its decline from five detections in 2015, 14 in 2013 and 2011, 46 in 2009. Twelve were detected in 2007 (Dunning, Riegel 2017).

Alteration of habitat type would occur and possibly impact this species if they are present. Because of their mobility and availability of adjacent habitat, the proposed project should not have adverse effects to the viability of the cerulean warbler.

Concerning the loggerhead shrike and barn owl, past sightings of the shrike are from over 50 years ago and there have been no sightings of the barn owl. Open areas exist in the cumulative effects boundary but these two species are not considered present.

Consequently, there would be no impact to these species. Their habitat would be impacted in a beneficial way through prescribed burning and enhancement of early successional areas.

American woodcock is present within the project area. Twelve woodcocks were counted during surveys in 2014 and eight in 2016 (Harriss 2014a, 2016). Project activities would promote habitat for the woodcock by enhancing early successional areas, diversifying botanical resources and the creation of vernal pools. Therefore, the Houston South Project would have a beneficial impact to the American woodcock.

Temporary disturbance to the discussed RFSS bird species may occur if they inhabit these areas, but sufficient amounts of undisturbed habitat exists nearby. Because of their mobility and positive long-term effects to their habitat, there are no anticipated adverse effects to the viability of these bird species from proposed project activities.

Fish

There are six fish species currently on the RFSS list. The northern cavefish (*Amblyopsis spelaea*) is restricted to springs or subterranean cave waters. No caves were located in the project area. The eel (*Anguilla rostrata*) and lake sturgeon (*Acipenser fulvescens*) have large river requirements that are not present in the project area. The last three fish, the spotted darter (*Etheostoma maculatum*), northern madtom (*Noturus stigmosus*), and channel darter (*Percina copelandi*) have habitat in the area but were not found during surveys. Fish sampling has taken place in the project area since 2017 and these fish are not considered present.

Due to lack of potential habitat or the lack of species in the project area, there would be no impact to any RFSS fish species for the Houston South Project.

Reptiles

The timber rattlesnake (*Crotalus horridus*) has recorded sightings in the Pleasant Run Unit (IDNR 2015, 2012). Dry forest habitat exists in the project area and timber rattlesnakes are likely to be present. However, the project area is not where the majority of consistent sightings have taken place.

Temporary disturbance to individual timber rattlesnakes may occur during project activities, if they do inhabit the project area, but a sufficient amount of undisturbed habitat exists nearby.

Timing of prescribed fire is critical to the timber rattlesnake and is best applied during their natural dormant season. Growing season fires should be expected to produce some mortality and possibly high mortality under some conditions.

If hibernacula occur on the site, burning during the early growing season is more likely to have a direct effect on several snake species than burning during the dormant season

before they emerge. However, burning during the early growing season does not necessarily equate to negative effects.

Low-intensity fire does not consume pre-existing large, coarse woody debris that is important as cover for many herpetofauna. Timber rattlesnakes are most vulnerable to fire soon after they emerge from winter hibernacula. Early growing-season fire poses a risk to these animals, especially when burning near known hibernacula and when burning relatively large areas (Harper, C.A., Ford, W.M., Lashley, M.A. et al. 2016).

To date, there are no known rattlesnake hibernacula in the project area. If hibernacula sites are discovered through future research, fire lines and/or restrictive dates may be imposed for that area.

Prescribed fires pose a threat for the timber rattlesnake adjacent to hibernacula; therefore, the Houston South Project may impact the timber rattlesnake. Due to this species being listed as apparently secure (NatureServe 2019), few sightings in the area, design criteria and the availability of existing cover habitat adjacent to the project area, there should be no trend toward federal listing to this species from implementation of this project.

Amphibians

The two listed RFSS amphibians are the green salamander (*Aneides aeneus*) and four-toed salamander (*Hemidactylium scutatum*). The green salamander is in isolated populations found further south on the Tell City Ranger District. Due to the lack of suitable habitat (cliff communities), the species is considered not present and there would be no impact to this species or their habitat.

The four-toed salamander occurs in an isolated population in the Pleasant Run Unit over seven miles from the project site. These species prefer boggy wet sites in forested areas. These areas are not conducive to prescribed fire, any negative impacts from these treatments would be unlikely. If the four-toed salamander is present, it is possible the salamander could be beneficially impacted due to the installment of vernal pools and AOPs. Therefore, the project would result in a beneficial impact to this species if present.

Mollusks

All of the mollusk species on the RFSS list have rivers or large streams habitat requirements that are not present in the project area. For these species, the project proposal would have no impact to these species or their habitat.

Terrestrial Invertebrates

West Virginia white (*Pieris virginiensis*) inhabits mesic forest communities associated with streams. These types of communities are present in the project area. Prescribed burning during the growing season could impact this species however; growing season

burns would be less common. The West Virginia white is considered vulnerable in Indiana and nation-wide.

Since the entire project area would not be burned at once and activities would be implemented over a several years, untouched adjacent forest would be available for refugia. Prescribed burns could promote more botanical diversity for this species; therefore, the Houston South Project may impact the West Virginia white. Due to few sightings in the area, few growing season burns and the availability of existing cover habitat adjacent to the project area, there should be no trend toward federal listing.

The monarch butterfly (*Danaus plexippus*) are a wide-ranging species but closely tied to milkweed plants. These plants can be found in early successional areas, roadsides and private lands throughout the project area to varying degrees. Design criteria would promote pollinator/butterfly habitat for the project through seeding and improving forest health.

The Houston South Project may impact and possibly have a beneficial impact to the monarch butterfly. Due to few growing season burns and the availability of existing habitat adjacent to the project area and since this species is listed as apparently secure (NatureServe 2019), there should be no trend toward federal listing.

All other terrestrial invertebrate species on the RFSS list have habitat requirements that are not present in the project area.

Karst Invertebrates

All of the karst invertebrate species on the RFSS list have habitat requirements that are not present in the project area. Due to the distance of caves from the project area (over 3.5 miles), no impacts from prescribed fire are expected.

No Action

With this alternative, none of the proposed action would occur. No action could have negative impacts on the RFSS. Bat species would not have the beneficial effects of vernal pools. Habitat creation for the ruffed grouse would not occur. Improvements to habitat for the American woodcock and Henslow's sparrow would not occur. Opportunities to promote pollinator/ butterfly habitat would be lost. Foraging and travel corridors used by bat species would not be improved.

Cumulative Effects for Issue 9

There are no municipal, county, or state projects known to be proposed within the action analysis area. However, it is assumed that standard maintenance on highways, county roads and rights-of-way would continue. Past activities that have likely affected RFSS species within the Forest boundary include conversion of riparian areas to agricultural or residential uses, timber harvest, wildfire, and grazing. Present or reasonably foreseeable future activities, which may have an impact on these species, include the construction or use of roads, continued agricultural use, timber harvest and activities associated with

residential development. Private lands near the proposed action area will continue to be a mix of forest, open pasture and crop fields.

The past, present or foreseeable Forest Service activities near the project area that could directly or indirectly impact the RFSS are: the continuation of early successional management (Forest Openings Maintenance), wetland maintenance, the Buffalo Pike Project, potential trail re-routes, Pleasant Run Road Decommissioning, Lake and Pond Habitat Improvement, Jackson County AOPs, Fork Ridge Restoration, and NNIS herbicide applications.

These activities have been analyzed under separate decisions and would not add any negative impacts to the RFSS. The vast majority of these activities are considered to have a long-term beneficial impact on local bat species.

The Houston South Project would contribute no detrimental cumulative impacts to RFSS species. An ongoing project (Buffalo Pike) has been determined to have beneficial impacts to the ruffed grouse and American woodcock. This would be a cumulative beneficial impact. Also, under this ongoing project, the West Virginia white, timber rattlesnake, little brown bat and tricolored bat had “may impact” determinations. It was also determined for these five species that there would be no negative impacts and no trend toward federal listing. Therefore, there are no cumulative negative effects.

Issue 10: Concern that project activities could increase the potential spread of plant NNIS

Indicator:

- Miles/acres disturbed for road, skid trail, and log landing construction
- Acres of harvest

For Issue 10: Analysis Area:

The spatial boundary used to evaluate direct and indirect effects is the action areas consisting of the proposed project activities. The spatial boundary used to evaluate cumulative impacts is the proposed project area, plus the adjacent lands up to 1,000 feet beyond those areas proposed for ground disturbing activities. Factors influencing the spread of existing infestations or establishment of new populations would result from the start of the disturbance to no more than four years after completion of the activity. Considering project activities may continue for up to 20 years, the temporal consideration for cumulative effects is 24 years.

Direct and Indirect Effects for Issue 10

Proposed Action

Current NNIS populations

Project level site-specific surveys conducted have located NNIS plant infestations both within and near activity areas of the Proposed Action. The primary locations of these populations and areas with the largest existing infestations are along current and past

disturbance corridors: roads, trails, maintained rights-of-way (power and gas lines) and old road corridors (spread vectors). Other sites with infestations are underneath conifer stands in areas with past disturbances and old fields established from past use as pastures and homesteads. Additionally, infestations occur in small wildlife openings, old timber harvest areas, and near areas of past wind throw and blowdown.

Ongoing and future site-specific invasive plant surveys would continue throughout the Houston South project area prior to and during implementation of any ground disturbance associated with this project. The primary focus areas of these surveys are the areas that have the greatest likelihood for spread of invasive plants. These areas consist of proposed harvest and prescribed burn units, as well as proposed road construction and reconstruction, skid trails, and log landing areas. Another focus of these NNIS surveys is to continue locating all high priority species' infestations within the project area for possible inclusion in future control treatment activities.

We estimate that old fields located throughout the project area contain at least some level of infestation containing tall fescue and Chinese lespedeza within the 123 wildlife openings in the project area. These areas could contain an estimated 165 acres of invasive species.

The NNIS located in old fields have a much longer history of establishment and disturbance, so the infestations are often larger and exist with higher infestation rates. Similar results occur for trails, roads, and some ROWs infestations, especially where they occur in close proximity to old fields. The most abundant invasive plants in these old fields are tall fescue, multiflora rose, autumn olive and Japanese honeysuckle, but because of wide dispersal by birds, they also exist in widely scattered locales throughout the project area underneath the forest canopy.

Japanese stiltgrass is commonly seen throughout the Houston South project area along shaded roads, ditches, trails and ROWs. Current surveys estimate that at least 85 percent of the proposed roads and trails to be used for this project contain some level of stiltgrass infestation, with infestations usually reaching an average of 3.5 feet beyond road edges.

Although they are not included on Forest NNIS listings, the various pine species are not native to the Hoosier National Forest. Some of these species have adapted well after tree plantings from the 1930's to the mid 1980's, and from this seed source, new young seedlings are surviving in selected areas of the project area. The project proposal includes removing pines in these pine plantations, a nonnative species that is at least somewhat invasive. Many of these stands have higher infestations of invasives than their neighboring hardwood stands due to past disturbance and the shelter and roosting locations pines provide for NNIS carrying birds. Clearcutting these areas would likely promote the spread of NNIS currently in the understory once the canopy is opened and more light penetrates to the forest floor.

Risk of Spread and New Introductions

The proposed harvest activities would create a mosaic condition of disturbed vegetation that could facilitate the spread of NNIS plants, depending on where these areas are in proximity to current infestations. Nonnative invasive plant populations would likely increase within the project area regardless of the alternative selected, including no action.

By properly implementing project level design measures, the Hoosier anticipates a low to moderate risk for new introductions and possible spread of NNIS plants associated with the project activities. Because NNIS plant infestations occur throughout the project area, there is the likelihood that disturbance from logging activities and subsequent prescribed burning could indirectly spread invasive plants or provide new areas for them to colonize in the action alternative. Current inventories show that NNIS populations exist primarily in old fields and the along roads and trails leading to them. These areas are the locales with the greatest likelihood for project activities directly contributing to the spread of invasive plants. Locales further to the interior of the forest stands, and especially in hardwood stands, contain fewer infestations and much reduced net infested acres of NNIS populations.

By diligent and proper application of invasive plant control treatment using an integrated pest management process in appropriate areas where feasible and necessary, we anticipate a further reduction for the possible spread of NNIS plants through implementation of the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a). Subsequent application of control treatments in future years, plus using an adaptability process to control those infestations not yet known within the project area, would contribute to maintaining the ecosystem and reducing the level of NNIS plant infestations spreading to new areas.

Timber Harvest and Prescribed Burning

Harvest activities increase disturbance, creating potential for NNIS plant spread. The indicator of response area chosen to evaluate the effects of the various resource concerns by the proposed project activities is the 100-foot distance where treatment would occur and its corresponding acreage. There are 25 known species documented within the project area. Ten species, including tall fescue, inhabit open habitat conditions along roadsides or in wildlife openings. Any shade-intolerant NNIS plants invading forests from these open areas would decline as the forest ages through natural succession. Other species most often grow best in open conditions but can also persist underneath the forest canopy. The two invasive plants with occurrences in the project area that inhabit shaded conditions and pose the greatest threat to natural ecosystems are Japanese stiltgrass and garlic mustard. These species are more likely to spread in areas receiving uneven-aged treatments rather than even-age harvests. Infestations of these two species occur primarily along trails or shaded roadside ditches next to forest edges, and riparian stream zones or draws.

Tree-of-heaven occurs in insolated patches in the project area. Where infestations occur within harvest units or they exist nearby, probable expansion of the populations would occur depending on the level of disturbance and age of the trees. Treatment of these

patches, prior to implementation of silvicultural or burning activities, would be a high priority.

Japanese stiltgrass prefers moist conditions and is very shade-tolerant. Infestations occur primarily along road shoulders and horse trails. Site-specific surveys reveal that stiltgrass occurs more often and in greater abundance in pine stands than in hardwood stands. The species spreads primarily by movement of seeds and plant fragments; thus roadwork, harvest and fire line activities have the potential to contribute to the expansion of these populations because of ground disturbance or movement of equipment. The extent of possible expansion and new colonization directly or indirectly depends on where these actions occur in proximity to the populations. Pine clearcutting would increase light and create drier conditions that may remove or decrease some existing stilt grass populations that occur within units, but at the same time contribute to spreading the species to other nearby locales. Pine thinning harvesting is not likely to reduce light levels enough or diminish moisture conditions to eliminate existing populations in these units, so ground-disturbing activities in these areas could possibly expand existing stilt grass infestations.

Although existing old-fields and wildlife openings are the sites with a great number of NNIS plants, generally, these fields do not occur within proposed harvest units. In some instances, small portions of wildlife openings and old-fields lie in the units or they occur adjacent to the units. Many of the invasives in these openings include those species that are not shade-tolerant and cannot effectively invade forested areas, only the edges.

The project proposal includes up to 13,500 acres of prescribed fire. Fire is a historic part of the central hardwood ecosystem. The Forest would conduct prescribed fires in large landscape burns to minimize the amount of fire line construction. Where possible, existing roads, trails or ROWs would be used as fire lines. New fire lines necessary to contain prescribed fire would be put in place where needed. These lines are generally placed a short time before the burn and are constructed using chainsaws and leaf blowers. Creation of fire lines in this manner would change habitat for the short-term, returning to their previous state more quickly than when fire lines are constructed to bare mineral soil. The Hoosier would consider burning on private lands, if and after obtaining agreements from landowners, to further minimize soil disturbance from less needed fire lines.

Prescribed burning produces mixed effects on NNIS plants depending on the individual species, the timing of the burn, and fire intensity. Burning contributes to disturbance that can create conditions susceptible for new invasive plant invasion or expansion of existing infestations. Fire would create a nutrient flush for a short period that would benefit both native and invasive plants. In areas where herbicide application may occur, timing the application to follow landscape-burning projects could improve the effectiveness on controlling NNIS plants.

Road Construction, Fire line Construction and Trails

The highest potential for establishment and spread of invasive plants are newly disturbed areas. Reconstructed and some of the newly constructed roads occur along old road beds that already contain NNIS. Trails used to access silviculture treatments would likely be

widened and the surfaces impacted by equipment and/or tree skidding. While fire lines would occur on existing corridors (roads, trails, rights-of-ways, etc.) there would be up to approximately 21 miles of newly created fire line to tie into the existing corridors.

System and temporary road reconstruction activities would likely facilitate transport and spread of invasive plants. Ground disturbance would vary among roads proposed for reconstruction, as some require higher levels of work to meet necessary road specifications. Land adjacent to the roadways where clearing would occur provides the most likely site for possible NNIS colonization or spread. Where the proposal uses portions of trails for logging activities, similar if not greater potential exists for possible expansion of NNIS because greater clearings widths are probable, and most areas already have infestations of Japanese stiltgrass. Generally, road maintenance involves less ground disturbance that could potentially spread NNIS infestations, but actions such as ditch work or culvert maintenance and replacement and AOP construction would contribute to spreading invasive plants, depending on proximity of infestations to work performed, into drainages and waterways.

The new system roads would continue to act as potential spread vectors for invasive plants after implementation. The project proposes to close and decommission all temporary roads upon completion of the sale. This action would create some additional disturbance, but it restricts further passage along roadways after road closure, thereby reducing possible spread of invasive plants in the future. The project proposal would also remove approximately 2.7 miles of roads from the system by decommissioning, where they would be brushed in or have barrier posts placed to prevent equipment access and use, also reducing possible spread of existing NNIS in the future.

New fire line construction would be necessary to connect with existing corridors (roads, trails, rights-of-way). Many of these existing corridors are already infested with Japanese stiltgrass and other invasives and could act as potential spread vectors during fire line construction and fire implementation.

The Forest would revegetate some areas (landings, skid trails, etc.) using approved seed mixes that should alleviate some probability for spreading NNIS plants. Where appropriate and feasible, the Hoosier would consider pre-treatment herbicide application on selected NNIS infestations along some roads or roadside shoulders and selected trails prior to these construction activities to reduce the likelihood of plants spreading. Also, treatments would occur post-implementation under the existing NNIS Program of Control (USDA FS 2009a).

Table 8 displays the proposed silvicultural and prescribed fire treatments and the sum of acres located within the 100-foot road and trail buffer area (Indicator of Response). These include both the new disturbances and the use of existing corridors and the AOPs. Overall, the total of these disturbances and their buffers signify the amount of acreage that have the most potential for NNIS spread (Indicator of Response) within the proposed Houston South project area: 3,248 acres.

Table 9: Potential NNIS Indicator of Response

Proposed Activity	Vegetation Type	Vegetation	Roads/ Trails	100 Feet Buffer of Roads and Trails
Silvicultural Treatments				
Clearcut	Pine	401 ac	16.36 mi Road 14.5 mi Trail	748 ac
Shelterwood	Hardwood	703 ac		
Thinning	Pine/Hardwood	2,405 ac		
Selection	Hardwood	462 ac		
Prescribed Burning Treatments				
Burn	Multiple types	Up to 13,500 ac*	40.2 mi Road* 11.6 mi Trail* 19.3 mi Fire line^ 14.9 mi Other#	2080 ac
Total Buffered roads/trails			116.86 mi	2,828 ac
Timber Skid Trail and Log Landing areas				417 ac
3 Aquatic Organism Passage (AOP) replacements				~4 ac
TOTAL NNIS Indicator of Response				3,248 ac

*Some Burn miles and acres overlay some of the same areas as those associated with Silvicultural treatments, but they will be impacted differently and at different times, therefore they are recounted for the totals.

^ represents existing and new fire line construction.

includes: ag field edge, pipeline ROW, Skid trails, streams and railroad ROW

The species of most concern for spread in these project areas is Japanese stiltgrass due to its widespread current infestation throughout the road and trail systems. Priority treatments cannot cover all these trails and roads, and would likely instead target skid trails and fire lines, after implementation, where new infestations could be prevented from establishing and spreading beyond current, well-established infestations. Around the proposed AOP sites, garlic mustard and Japanese stiltgrass are present, so in these areas an effort to remove any garlic mustard within the first couple years after construction should prevent establishment and spread along waterways.

The primary objective regarding NNIS plants is to avoid introducing new infestations and slow the spread of existing populations affected by project activities. Prevention measures include equipment cleaning prior to implementation, avoiding increased disturbance near existing populations (particularly for designating log landings), using gravel to cover small bands of NNIS to prevent their spread by equipment, and using native or non-persistent, nonnative species in areas requiring revegetation.

A portion of funds from the timber sales would be used to treat invasives within the stands (Knutson-Vandenburg budget authority). These treatments are often planned for three to five consecutive years, after implementation, depending on the invasive species present and their infestation levels. Coordination between timber and botany staff would determine the areas of highest need for treatment, the species to be treated, and the amount of consecutive treatments needed.

No Action

Active nonnative invasive plant colonization and establishment as influenced by ongoing activities within the project area would continue at current rates. Any change to the rate of spread of NNIS plants would depend upon existing Forest projects that overlap the project area and any other future invasive plant control done according to the Nonnative Invasive Species Plant Control Program Analysis within or adjacent to the project area. The rate of spread, however, under the no action alternative would be less because of no increase in ground disturbance. Risks to rates of NNIS plant expansion under this alternative would depend upon human disturbances and available funding to mitigate effects caused by those actions not associated with the Houston South project.

With no action, NNIS would continue to spread and increase and would displace valuable wildlife habitat, threaten biodiversity, and potentially affect rare plant communities or individual rare plant populations. However, this spread and increase would be less than that likely to occur under the Proposed Action.

Cumulative Effects for Issue 10

Nonnative invasive plants occur throughout the cumulative effects area on NFS lands, as well as adjacent private ownership. For many species, establishment of these populations occurred prior to the existence of the Hoosier National Forest or NFS ownership.

Invasive plants will continue to invade and spread across the landscape. The cumulative effect of implementing the action alternative combined with ongoing human and natural disturbances is the continuing spread of these species. The actions and processes differ in various locations in the project area and across the Forest, so the rate of spread would also differ. Vehicles, equipment, wind, rain, animals, and humans have the potential to carry invasive plant seed to uninfested areas. This spread really has no limit other than the susceptibility of the receiving habitats. Given the inherent susceptibility of some habitats across the Forest and within the project area, spread is likely. At the same time, Forest-wide NNIS plant management and site-specific project level control activities are increasing, which could result in reduced invasive plant populations in areas of treatment for the Houston South project. The Hoosier National Forest is currently working with Forest Research staff and specialists from other National Forests in the region to develop protocols for post-treatment of log landings and skid trails to establish native plant species that will benefit pollinators and other wildlife species, while competing with NNIS. Initial efforts by the Hoosier National Forest have been variable, but with continued collaboration, data collection and monitoring, we hope to increase our successful revegetation of these impacted areas.

Ongoing Hoosier National Forest projects within the Houston South projects area such as the Forest Openings Maintenance EA (USDA FS 1999), which continues implementation of both mowing and prescribed burning, may provide some limited NNIS control, but this is not one of its primary objectives. Trail maintenance requires brushing/mowing in some areas to prevent vegetation encroachment on the trail; it also can require gravel placement along the trail with equipment to harden the trail tread. If mowing activities occur outside

of the season when stiltgrass reproduces, this would help prevent the movement of seed by mowers during wildlife opening, fire line clearing, and trail maintenance activities.

Private landowners are sporadically taking action against NNIS on their lands, with some actions possibly occurring within the project area. An increased interest of private landowners in controlling of NNIS (SICIM 2019) through local Cooperative Invasive Species Management Areas (CISMAs), will help reduce uncontrolled NNIS spread on private lands and rights-of-way. In 2018, the Jackson County Cisma co-sponsored a workshop on controlling NNIS along ROWs for road maintenance personnel. This group is also raising the awareness of NNIS and their impacts to private landowners in the area.

Past and present disturbances, when added to reasonably foreseeable actions, have an effect on the expansion of NNIS through distribution of seed, ground disturbance, and the creation or perpetuation of spread vectors. The degree of effects would vary depending on the number of entrances over time, distribution of disturbance across the Forest, the proximity of infestations, and number of acres disturbed. The Hoosier manages more than 200,000 acres that are intermixed with lands of other ownerships. Since invasive plant infestations occur at widely scattered locations on both private and NFS lands, land use decisions made by other owners may affect the spread of invasive plants as much as activities carried out by the Hoosier. Land use decisions made by other owners also could influence the effectiveness of the future colonization of NNIS, depending on the proximity of existing infestations to any ground disturbance. Other ownership exists within and around the project area: what and how other landowner's create disturbance on their lands would affect NNIS spread on these acres.

Continued implementation of the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a) in selected portions of the project area where most needed according to the identified treatment priorities, would work against the cumulative effect of other activities that create conditions for the spread of NNIS. Forest Service regional and national direction for NNIS management emphasizes an approach of early detection and rapid response to detecting new infestations and invasive plant control (USDA FS 2003, 2004). To act quickly in response to any new infestations that may result from project activities, the Forest would use hand, mechanical control, and herbicides on NNIS plants where needed and appropriate to best meet this direction.

The Forest Openings Maintenance project includes prescribed burning and mowing on scattered locations in the Houston South project area (USDA FS 1999). Generally, mowing does not create ground disturbance and would reduce seed production of invasive plants as well as native plant species, depending on timing of mowing and seed development. If the Forest chooses to implement the proposed action, then any future NNIS control treatments would undergo a coordinated effort to provide improved effectiveness where work would occur in the same areas as identified in the Forest Openings Maintenance project.

A related foreseeable project involving old-fields and existing wildlife openings in the project area is the Pleasant Run Habitat Improvement. This future project would include

all wildlife openings in the prior Forest Openings Maintenance EA, as well as other new land acquisitions that contain early successional habitat areas managed for wildlife resources. The project would most likely expand the use of treatment techniques beyond just mowing and prescribed burning to include herbicides, chainsaws, machinery, native species planting, road maintenance, and creation of vernal pools. This project would involve ground-disturbing activities that could expand or create new areas for colonization of NNIS plants depending on the proximity of activity areas to existing infestations.

Other reasonably foreseeable projects are ongoing Forest trail maintenance, county and state road maintenance, and utility ROW maintenance. As part of highway maintenance activities, some limited roadside herbicide application has occurred along various highways across the Forest. This action may occur where allowable along state roads 135 and 58. Trucks, with a much greater potential for adversely affecting non-target species, normally do roadside herbicide spraying. County and Township road maintenance has not been observed for NNIS, but more for clearing areas of vegetation around guard rails. All County and Township roads driven in the project were noted to have Japanese stiltgrass somewhere along their length. Likely, the infestation is similar to or higher than that estimated for Forest roads and trails, because of the higher incidence of maintenance (mowing) that spreads NNIS. Many of the utility ROWs have Japanese stiltgrass and other NNIS within them, likely spread during maintenance activities of these areas.

Trail maintenance activities have potential to spread NNIS such as Japanese stiltgrass if it exists where this work would occur. Scattered infestations of stiltgrass occur throughout the Hickory Ridge trail system where trail maintenance work would occur annually. Because the work occurs mostly to the existing trail, there are few affects to nearby vegetation. However, if done at the proper time just before seed set and release, mowing can provide some effective control of Japanese stiltgrass especially if done repeatedly.

Cumulatively, projects that involve direct or indirect NNIS control assist the Hoosier to resist the introduction of NNIS plants within the Houston South project area. Subsequent work under the current Nonnative Invasive Species Plant Control Program Analysis (2009a) could include both NNIS control treatments and restoration activities where appropriate and needed. With implementation of the Proposed Action, the Hoosier would coordinate all of the Forest NNIS control activities where they overlap with actions proposed within the project area to maximize effectiveness for control of and minimize possible negative effects to desirable non-target vegetation.

Issue 11: Concern that vegetation manipulation or timber harvest, coupled with climate change could negatively impact the local environment

Indicator:

- Project activities contributing to greenhouse gasses and climate change

For Issue 11: Analysis Area: The effects analysis for greenhouse gas emissions is the global atmosphere given the mix of atmospheric gases can have no bounds. The timeframe for the analysis is 20 years because all project activities should be completed by then.

Direct and Indirect Effects for Issue 11

Proposed Action

Climate change is a global phenomenon because major greenhouse gasses (GHGs)¹ mix well throughout the planet's lower atmosphere (IPCC 2013). Considering emissions of GHGs in 2010 were estimated at $13,336 \pm 1,227$ teragrams carbon globally (IPCC 2014) and 1,881 teragrams² carbon nationally (US EPA, 2015), the Houston South project makes an extremely small contribution to overall emissions. Because local GHGs emissions mix readily into the global pool of GHGs, it is difficult and highly uncertain to ascertain the indirect effects of emissions from single or multiple projects of this size on global climate. Relative to the amount of carbon stored and sequestered by the Hoosier National Forest, this proposed action's direct and indirect contribution to GHGs and climate change are minor.

From 2000 to 2009, forestry and other land uses contributed 12 percent of the human-caused global CO₂ emissions³. The forestry sector's contribution to GHG emissions has declined over the last decade (IPCC 2014, Smith et al. 2014, FAOSTAT 2013). The largest source of GHG emissions in the forestry sector globally is deforestation (e.g., conversion of forest land to agricultural or developed landscapes) (Pan et al. 2011, Houghton et al. 2012, IPCC 2014). However, forest land in the United States has had a net increase since the year 2000, and this trend is expected to continue for at least another decade (Wear et al. 2013, USDA FS 2016).

The relatively small quantity of carbon released to the atmosphere and the short-term nature of the effect of the proposed actions on the forest ecosystem are justified, given the overall change in condition increases the resistance to insects, disease, wildfire, age related declines in productivity, or a combination of factors that can reduce carbon storage and alter ecosystem functions (Millar et al. 2007, D'Amato et al. 2011). Furthermore, any initial carbon emissions from this proposed action will be balanced and possibly eliminated as the stand recovers and regenerates, because the remaining trees and newly established trees typically have higher rates of growth and carbon storage (Hurteau and North 2009, Dwyer et al. 2010, McKinley et al. 2011).

¹ Major greenhouse gases released as a result of human activity include carbon dioxide (CO₂), methane, nitrous oxide, hydrofluorocarbons, and perfluorocarbons.

² This report uses carbon mass, not carbon dioxide (CO₂) mass, because carbon is a standard unit and can easily be converted to any other unit. To convert carbon mass to CO₂ mass, multiply by 3.67 to account for the mass of the oxygen (O₂).

³ Fluxes from forestry and other land use (FOLU) activities are dominated by CO₂ emissions. Non-CO₂ greenhouse gas emissions from FOLU are small and mostly due to peat degradation releasing methane and were not included in this estimate.

The proposed activities in the Houston South project are not considered a major source of GHG emissions. Forested land would not be converted into a developed or agricultural condition or otherwise result in the loss of forested area. In fact, forest stands are being retained and harvested and prescribed burned to maintain a vigorous condition that promotes tree growth and productivity, reduces insect and disease levels and supports sustainable ecosystems, thus contributing to long-term carbon uptake and storage.

Some assessments suggest that the effects of climate change in some United States forests may cause shifts in forest composition and productivity or prevent forests from fully recovering after severe disturbance (Anderson-Teixeira et al. 2013), thus impeding their ability to take up and store carbon⁴ and retain other ecosystem functions and services. Climate change is likely already increasing the frequency and extent of droughts, fires, and insect outbreaks, which can influence forest carbon cycling (Kurz et al. 2009, Allen et al. 2010, Joyce et al. 2014). In fact, reducing stand density, one of the goals of the Houston South project, is consistent with adaptation practices to increase resilience of forests to climate-related environmental changes (Joyce et al. 2014). This project is consistent with options proposed by the IPCC for minimizing the impacts of climate change on forests, thus meeting objectives for both adapting to climate change and mitigating GHG emissions (McKinley et al. 2011).

The wood and fiber removed from the forest in this proposed action will be transferred to the wood products sector for a variety of uses, each of which has different effects on carbon (Skog et al. 2014). Carbon can be stored in wood products for a variable length of time, depending on the commodity produced. It can also be burned to produce heat or electrical energy or converted to liquid transportation fuels and chemicals that would otherwise come from fossil fuels. In addition, a substitution effect occurs when wood products are used in place of other products that emit more GHGs in manufacturing, such as concrete and steel (Gustavasson et al. 2006, Lippke et al. 2011, McKinley et al. 2011). Removing carbon from forests for human use can result in a lower net contribution of GHGs to the atmosphere than if the forest were not managed (McKinley et al. 2011, Bergman et al. 2014, Skog et al. 2014). The IPCC recognizes wood and fiber as a renewable resource that can provide lasting climate-related mitigation benefits that can increase over time with active management (IPCC 2000). Furthermore, by reducing stand density and restoring historic composition, structure, and function, the proposed action may also reduce the risk of more severe disturbances, such as insect and disease outbreak and wildfires, which may result in lower forest carbon stocks and greater GHG emissions.

No Action

There would be no vegetation treatments implemented under the No Action Alternative, and thus no removal of trees from the project area. Stand densities would continue to increase causing competition for limited resources. This could lead to tree stressors that lend themselves to increased insect and disease outbreaks and mortality, decreasing the resilience of forests to climate-related environmental changes. Conditions that promote

⁴ The term “carbon” is used in this context to refer to carbon dioxide.

tree growth and productivity contributing to long-term carbon uptake and storage would not be achieved.

Cumulative Effects for Issue 11

Because the direct and indirect effects would be negligible, the proposed action's contribution to cumulative effects on global GHGs and climate change would also be negligible. Carbon emissions during the implementation of the proposed action would have only a temporary influence on atmospheric carbon concentrations, because carbon will be removed from the atmosphere with time as the forest regrows, further minimizing or mitigating any potential cumulative effects.

Issue 12: Harvesting timber could decrease the rate of carbon sequestration

Indicator:

- Change in carbon sequestration rates

For Issue 12: Analysis Area: The effects analysis area for carbon includes forested lands within the Hoosier National Forest because this is where timber harvest and prescribed burning treatments are proposed where carbon stocks may be affected. The timeframe for the analysis is 20 years because all project activities should be completed by then.

Forests play an important role in the global carbon cycle by sequestering carbon from the atmosphere and storing it in biomass and soil. Forestry has gained attention in recent decades because of its potential to influence the exchange of carbon with the atmosphere, either by increasing storage or releasing carbon emissions. Forests can take up and store atmospheric carbon through photosynthesis and release carbon through mortality, plant respiration, microbial decay, fire, and use of wood fiber. Forests can store carbon in soils and plant material as well as in harvested wood products that store carbon outside of the forest ecosystem. In addition, wood fiber can be used to substitute for products that are more energy-intensive to produce, such as concrete and steel, creating a substitution effect which can result in lower overall greenhouse gas emissions.

A complete and quantitative assessment of forest carbon stocks and the factors that have influenced carbon trends (management activities, disturbances, and environmental factors) for the Hoosier National Forest is available in the project record (Dugan et al. 2019). This carbon assessment contains additional supporting information as well as references for this proposed action.

Direct and Indirect Effects for Issue 12

Proposed Action

Forests in the Hoosier National Forest are maintaining a carbon sink. Forest carbon stocks have increased by about 34 percent between 1990 and 2013 (USDA FS 2015), and

negative impacts on carbon stocks caused by disturbances and climate conditions have been modest and exceeded by forest growth.

Following natural disturbances or harvests, forests regrow, resulting in the uptake and storage of carbon from the atmosphere. Over the long term, forests regrow and often accumulate the same amount of carbon that was emitted from disturbance or mortality (McKinley et al. 2011). Although harvest transfers carbon out of the forest ecosystem, most of that carbon is not lost or emitted directly to the atmosphere. Rather, it can be stored in wood products for a variable duration depending on the commodity produced. Wood products can be used in place of other more emission intensive materials, like steel or concrete, and wood-based energy can displace fossil fuel energy, resulting in a substitution effect (Lippke et al. 2011). Much of the harvested carbon that is initially transferred out of the forest can also be recovered with time as the affected area regrows.

The proposed Houston South project includes both timber harvesting and prescribed burning treatments that would be conducted on approximately 13,500 acres. This scope and degree of change would be minor, affecting seven percent of the approximately 204,000 acres of forested land in the Hoosier National Forest. The effect of the proposed timber harvest focuses on aboveground carbon stocks that is stored in live woody vegetation and comprises about 45 percent of the ecosystem carbon stocks on the Hoosier National Forest. The effect of the proposed prescribed fire focuses on the understory and forest floor, which together comprise about nine percent of the Forest-wide ecosystem carbon stocks (USDA FS 2015). About 33 percent or more of the ecosystem carbon is in mineral soils, a very stable and long-lived carbon pool (McKinley et al. 2011, USDA FS 2015, Domke et al. 2017). The majority of the treatments will not remove 100 percent of the trees so not all of the 45 percent of the above ground carbon stock would leave the site.

Mineral soil is an important consideration for long-term carbon storage capacity in soils in most ecosystems. Timber harvesting generally results in a negligible amount of carbon loss from the mineral soils typically found in the United States, particularly when operations are designed in a way that minimizes soil disturbance (Nave et al. 2010, McKinley et al. 2011). Although timber harvest and prescribed fire can also affect the carbon stored in the understory and forest floor organic layer consisting of debris in various stages of decomposition, the carbon loss would be negligible given it is not stable or long-lived and would be replaced within months to a few years.

Forest management activities such as harvests and prescribed burns have characteristics similar to disturbances that reduce stand density and promote regrowth through thinning and removal, making stands and carbon stores more resilient to environmental change (McKinley et al. 2011). The relatively small quantity of carbon released to the atmosphere and the short-term nature of the effect of the proposed actions on the forest ecosystem are justified, given the overall change in condition increases the resistance to insects, disease, wildfire, age related declines in productivity, or a combination of factors that can reduce carbon storage and alter ecosystem functions (Millar et al. 2007, D'Amato et al. 2011). Furthermore, any initial carbon emissions from this proposed

action will be balanced and possibly eliminated as the stand recovers and regenerates, because the remaining trees and newly established trees typically have higher rates of growth and carbon storage (Hurteau and North 2009, Dwyer et al. 2010, McKinley et al. 2011).

No Action

There would be no timber or prescribed fire treatments implemented under this alternative. In the absence of timber harvesting on the stands, the forest would thin naturally resulting in dead trees that would decay in the long-term, emitting some carbon to the atmosphere, which may or may not be offset by forest growth. Over half of the stands on the Hoosier are middle-aged and older (greater than 80 years) and there has been a sharp decline in new stand establishment in recent decades (Birdsey et al., in press). If the Forest continues this aging trajectory, more stands will reach a slower growth stage in coming years and decades, potentially causing the rate carbon accumulation to decline and the Forest may eventually transition to a steady state or to a carbon source.

Cumulative Effects for Issue 12

Because carbon would be removed from the atmosphere with time as the forest regrows, any potential cumulative effects would be minimal or mitigated.

Effects Relative to the Finding of No Significance Impacts (FONSI) Elements

In 1978, the Council on Environmental Quality published regulations for implementing the National Environmental Policy Act (NEPA). These regulations (40 CFR 1500-1508) include a definition of “significant” as used in NEPA. The 10 elements of this definition are critical to reducing paperwork through use of a finding of no significant impact (FONSI) when an action would not have a significant effect on the human environment, and is therefore exempt from requirements to prepare an environmental impact statement (EIS). Significance as used in NEPA requires consideration of the following ten intensity factors in the appropriate context (or reference area) for that factor.

Mitigations and management requirements designed to reduce the potential for adverse impacts were incorporated into the Proposed Action, including standards and guidelines outlined in the Forest Plan, Best Management Practices, and project specific design measures based on resource specialist knowledge and experience. These mitigations and management requirements would minimize or eliminate the potential for adverse impacts caused by the proposed project.

1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.

Direct and Indirect Effects

The analyses prepared in support of this document considered both beneficial and adverse effects. Beneficial impacts have not been used to counterbalance negative impacts.

Adverse impacts were considered, and it was determined that those impacts do not result in a significant impact on the human environment. Although the management activities proposed may have some short-term negative effects to certain resources, impacts are largely beneficial to resources, especially in the mid to long-term and result in the project meeting its purpose and need.

Effects of the Proposed Action compared with No Action are discussed above in Effects Related to Relevant Issues. Although no issues were identified for sensitive plant species, it is Forest Service policy to prevent the loss of viability for sensitive species at the Forest level (Forest Service Manual 2670).

Plant Regional Forester Sensitive Species (RFSS)

Analysis Area: The spatial boundary used to evaluate direct and indirect effects are the action areas consisting of the proposed project activities. The spatial boundary used to evaluate cumulative impacts included a buffer of approximately 1,000 feet around the proposed project boundary.

Implementation of the timber activities would take about 12 years to implement, and the prescribed burns would occur over a 20 year period. Therefore, this analysis is using a 20 year time frame for evaluation of cumulative impacts.

Direct and Indirect Effects

Proposed Action

There are currently 34 plant RFSS (vascular and nonvascular) for the Hoosier National Forest. These sensitive species have known occurrences on the Forest and inhabit a diverse array of habitat.

On the Hoosier National Forest, RFSS occur in 10 community types and habitats, plus those wide-ranging species that use diverse habitats. The 10 community types are: dry forests, mesic forests, barrens, openlands, cliffs, caves and karst, wetlands, ponds and lakes, streams, and larger river habitat.

The proposed project area is in the Brown County Hills subsection on the Brownstown Ranger District and includes dry forests, mesic forests, openlands, wetlands, ponds and lakes, and streams. It does not contain barrens, cliffs, caves and karst, and larger river habitat. Therefore, the proposed project would have no direct, indirect, or cumulative effects to RFSS associated with those habitat types.

The two RFSS plants with known populations within the proposed project areas are Butternut (*Juglans cinerea*) and American ginseng (*Panax quinquefolius*). There are four RFSS with potential habitat in or around the project area: Trailing arbutus (*Epigaea repens*), Large yellow lady's-slipper (*Cypripedium pubescens*), Illinois woodsorrel (*Oxalis illinoensis*), and Yellow nodding ladies'-tresses (*Spiranthes ochroleuca*). We would anticipate similar effects, and apply equal protection measures, for any new RFSS plant populations discovered in the future in the proposed activity areas.

Of the three known butternuts in the project area, all are outside of proposed timber activities, but are inside proposed burn areas. For American ginseng, one population is outside both the proposed timber and burn areas. The remaining six are either in a timber treatment stand and/or a proposed burn area. However, some of these individuals are within stream corridors that would be protected from any timber activity due to Forest Plan (USDA FS 2006a) standards and guidelines. There are likely more undocumented individuals of these two species within the project area.

The remaining four species (Large yellow lady's slipper, Illinois wood-sorrel, yellow nodding ladies'-tresses, trailing arbutus) are not historically known in the project area and were not found during project surveys. They were still analyzed because they may occur in the proposed project areas, and/or have potential habitat that is altered.

Direct effects for all six species would be the loss of individuals during road and log landing construction, skidding, fire line construction or herbicide overspray. Known occurrences of plant RFSS would be protected from timber activities, fire line construction, and herbicide applications. The mesic forest species are highly unlikely to co-occur on ridgetops where road and log landings would be constructed. However, direct impacts to unknown RFSS could occur during timber skidding activities.

Timber herbicide applications would be made with selective applications (cut-stump, basal bark, stem injection, or foliar of seedlings) to individual trees, no broadcasting of herbicide would occur. Therefore, the likelihood of overspray onto unknown individual RFSS, while possible, is minimal. In addition, personnel applying herbicides would abide by project design measures. This would also reduce potential impacts to unknown populations of RFSS.

Possible indirect effects may occur to these six RFSS in the form of lost or altered areas of suitable habitat within the proposed activity areas. Indirect effects from timber activities would be the alteration of habitat to that of more open canopies, resulting in more light to the forest floor. For openland species this would be beneficial. For the dry forest species, this would likely also create beneficial habitat by reducing the canopy cover of shade-tolerant species (beech and maple) and promoting oak and hickory regeneration in this plant communities. All of the mesic forest species can exist in a continuum of different canopy densities. Large yellow lady's slipper would likely benefit from the increased light and butternuts from reduced humidity conditions created. American ginseng and Illinois wood-sorrel, the two most abundant RFSS on the Forest, may be impacted initially but are able to survive and persist in a disturbed landscape.

Burning activities would occur predominantly when plants are dormant, thus direct impacts are unlikely. If growing season burns do occur, fire intensity during green-up would likely be low and only top-kill individuals, leaving their roots to resprout the next year. Indirect effects to these species would be an alteration of habitat to more open midstories. For butternuts, a reduction in understory and midstory canopies (e.g. shrubs) could reduce humidity and reduce impacts of butternut canker. American ginseng has been found in areas of past burns and appears to be tolerant of the disturbance. Likewise,

large yellow lady's slipper has been found in areas previously burned and adjacent to permanent roads. This species seems to need the disturbance created by these activities to increase light to the forest floor. Illinois wood-sorrel has also been found in previously burned areas and appears tolerant of disturbance. Yellow nodding ladies'-tresses and trailing arbutus are most threatened by canopy closure and the loss of oak canopy, respectively. Thus, prescribed burns that reduce midstory and select for oaks over shade-tolerant species should be beneficial to these species.

No Action

There would be no timber or prescribed fire treatments implemented under this alternative, thus no direct impacts to any RFSS within the project area. Indirectly, those RFSS of dry forests would continue to have shade-tolerant tree species overtake their communities that could lead to population or habitat potential decline overtime as their habitat changes to a more mesic forest with dense overstory canopies. The openland species could still have open habitat due to wildlife opening maintenance activities. Mesic forest species would likely be unaffected.

Cumulative Effects

The implementation of the Proposed Action Alternative would be over a twelve year period for timber activities and up to 20 years for prescribed fire activities. As such, it is important to realize that proposed activities would not occur in a concentrated time frame and the direct and indirect effects would be spaced out both spatially and temporally.

Historically, the conversion of forest habitat to non-forest uses has contributed to the decline of the native species such as RFSS. Large areas in and around the Hoosier National Forest have been converted from native ecosystems to those characterized by both native and non-native plant monocultures. In addition to row crops, this would include pine plantations and areas dominated by the non-native invasive pasture grasses: tall fescue (*Festuca arundinacea*) and smooth brome (*Bromus inermis*).

Past activities on private land which have probably affected the native species in the vicinity of the action area include conversion of natural forest communities to agricultural or residential uses and high-grading timber harvests. Present or reasonably foreseeable future activities on private land that may affect RFSS include construction or use of roads, agricultural use of riparian areas, high-grading timber harvests, and activities associated with residential development in rural or forested areas. Private lands near the proposed action area would continue to be a mixture of forest, non-native open pastures, crop fields, and residential areas. Those area converted from forest often represent a complete loss of habitat for most plant RFSS and native woodland species.

Past activities on National Forest System lands that may have impacted the plant RFSS are timber harvests, trail reroutes, and prescribed burning. The Buffalo Pike project was implemented with similar mitigations to this proposed project and has had NNIS treatments for several years post-harvest. The harvest did not change the forest type; it was a restoration project similar to this proposed project. Forest Service trail reroutes are often done to move trails from areas where historic use (e.g. old road in riparian corridor)

combined with current use are detrimental to natural resources; they are instead placed in more resilient locations. Past burns occurred to manage tornado effects and safety concerns, maintain wildlife openings, and promote oak-hickory regeneration. All of these projects were surveyed for RFSS and analyzed prior to implementation.

Past, ongoing and reasonably foreseeable future activities on National Forest System lands within the project activities area that may affect RFSS include management of early successional habitats and routine maintenance of recreational trails. Without periodic mowing, brushing or burning, naturally occurring changes in vegetation would result in replacement of early successional habitats with forest habitats and loss of associated animal species (e.g. Henslow's sparrow, bobwhite quail, ruffed grouse). Likewise, trails would become unusable if vegetation is not prevented from encroaching on the trails. Other activities on trails include water bar maintenance and placement of rock or other materials to maintain trail surfaces and reduce erosion. Prescribed burning activities that are ongoing are to maintain wildlife openings and/or improve oak/hickory regeneration. These activities were all surveyed and analyzed for RFSS prior to implementation.

One of the greatest concerns, cumulatively for plant RFSS, is the introduction or spread of non-native invasive species (NNIS). Historical land-use in the area (farming, livestock grazing, homesites, roads, etc.) had already introduced some NNIS prior to some federal purchases of properties. Some NNIS were historically encouraged by state and federal agencies to plant for wildlife (autumn olive, multiflora rose, Chinese lespedeza), others were planted for horticultural interest (Japanese honeysuckle, multiflora rose, Japanese barberry, callery pear), or timber production (princess tree, tree-of-heaven), and some were introduced accidentally (Japanese stiltgrass). Today, public use for game and mushroom hunting, hiking, horse and bike riding, and other activities also have the possibility of introducing NNIS through propagule transport on shoes, livestock and equipment. Wildlife opening management, timbering activities, prescribed burning and trail maintenance/relocation activities also cause soil and vegetation disturbance that can increase the capability for NNIS to establish and spread. NNIS introductions and spread also occurs on non-federal lands where disturbance occurs to soil and vegetation.

Generally, for most NNIS plants within the cumulative effects area, their seed remains viable in the soil from two to seven years. For some species, their seed may lie dormant and remain viable for up to 15 or 20 years. Project design measures help reduce the introduction of new NNIS during project implementation. However, in spite of implementing mitigations and control measures, NNIS will continue to spread within the project area and in surrounding non-federal properties. Managing this spread will require long-term monitoring and early detection rapid response by natural resource staff for a decade or two in the project area. Management of NNIS would be done, both pre- and post-implementation under the Non-native Invasive Species Plant Control Program Analysis (USDA FS 2009a).

While all of the above-mentioned activities could have impacts to RFSS and/or their habitat, most of them have been ongoing for decades and have not driven any of the analyzed RFSS to a loss of viability or federal listing. Increased activity by the Forest

Service to treat NNIS within the area (Coon 2019, USDA FS 2009) would reduce introduction and spread potential. Meanwhile, an increased interest of private landowners in controlling of NNIS (SICIM 2019) through local Cooperative Invasive Species Management Areas (CISMAs), will help reduce uncontrolled NNIS spread on private lands and rights-of-way.

While the project cumulative effects may impact the six RFSS analyzed for the proposed project, the cumulative effects would not cause a loss of viability that would push any of the species to federal listing. Therefore, the overall determination for the six RFSS analyzed remains the same after adding the consideration of cumulative effects.

2) The degree to which the proposed action affects public health or safety.

Direct and Indirect Effects

The Proposed Action would not significantly affect public health and safety. Based on the analysis reported in this draft EA, there is no indication that the general public would experience any adverse health or safety effects from the treatments.

Effects of herbicide use can be found on pages 31-36. During project implementation, we would close certain sections of these trails for safety. As a result of the pre-planning and effective smoke management as required throughout the burns, the overall magnitude of effects is within the standards set to protect public health and safety.

Cumulative Effects

There would be no cumulative impacts of the proposed action to public health or safety.

3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

Direct and Indirect Effects

There would be no significant effects on unique characteristics of the area, because there are no parklands, prime farmlands, wild and scenic rivers, or ecologically critical areas affected by the Houston South Project. Any historical or cultural sites in the project area would be protected by applying avoidance methods (see item #8 below). Adherence to Forest Plan standards and guidelines would protect existing wetlands. The project would not negatively affect cave features because there are no known caves located in the project area. If a cave is located during implementation, protection measures would be implemented.

Cumulative Effects

Because there would be no direct or indirect effects on unique characteristics of the area, there would be no cumulative effects of the proposed action.

4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

Controversy in this context refers to cases where there is substantial dispute as to the effect of Federal action, rather than opposition to its adoption. The proposed project follows the management direction in the Hoosier National Forest Land and Resource Management Plan (USDA FS 2006a). There is no known scientific controversy over the anticipated effects of the proposed activities. The actions in the proposed project are well founded in science, current research, and other available information that is relevant to the actions. The Forest Service considered and reviewed numerous publications and research in support of our conclusions. This analysis integrated studies, professional knowledge, and site-specific surveys of the project area.

5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

Based upon consideration of past projects, the proposed action is not new or unique to the Forest. Projects with similar actions have been implemented on the Forest for many years. There are no unique or unusual effects for this project, which have not been previously encountered, which would constitute an unknown risk to the human environment. Project design measures (Appendix A) included with the Proposed Action, use of BMPs, and adherence to Forest Plan standards and guidelines would reduce and minimize to the point of non-significance any impacts that might have otherwise been uncertain, unique, or unknown. Further, the management actions proposed are consistent with the Hoosier National Forest Land and Resource Management Plan (USDA FS 2006a).

6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

The Proposed Action Alternative would not establish a precedent for future actions. The Responsible Official will base the decision to proceed on the results of site-specific environmental analysis conducted in accordance with the National Environmental Policy Act. Any future actions will be analyzed separately based on its own site-specific analysis.

7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

A cumulative effect is the consequence on the environment that results from the incremental effect of the action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the actions occur. A cumulative effects analysis was completed separately for each resource area. None of the resource

specialists found the potential for significant adverse cumulative effects (see individual cumulative effects analyses throughout the EA).

8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

Direct and Indirect Effects

After incorporating the design measures (see appendix A) that keep project activities from affecting cultural resources, there would be no effect to potentially significant sites. The Forest Heritage Resource Specialist would flag all eligible or potentially eligible National Register of Historic Places sites for avoidance of all ground-disturbing treatments. We would not use heavy machinery within the boundaries of a protected site area. A 10-20 meter (approximately 33-66 feet) zone flagged for avoidance would buffer sites requiring protection. A 30-meter buffer would be established around cemeteries. By following the design measures, there would be no direct or indirect effects to cultural resources.

We would conduct surface inspections of cultural resource sites during and after project implementation to ensure the design measures were effective in protecting the sites.

Cumulative Effects

By implementing required design measures, there would be no direct or indirect effects on heritage resources. Therefore, by definition, there would be no cumulative effects.

9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

In accordance with Forest Service Manual 2672.41, we review all Hoosier National Forests projects for possible effects on endangered, threatened, or proposed species. There are six federally listed species on the Forest, the endangered eastern fanshell mussel (*Cyprogenia stegaria*), the endangered rough pigtoe (*Pleurobema plenum*), the endangered sheepnose muscle (*Plethobasus cyphus*), the endangered gray bat (*Myotis grisescens*), the endangered Indiana bat (*Myotis sodalis*), and the threatened northern long-eared bat (*Myotis septentrionalis*). Presently, no federally listed endangered, threatened, or proposed plant species have known occurrences on the Forest.

Analysis Area: The geographic scope of the biological analysis for terrestrial plants and animals is based on the Ecological Classification System and determined by the Subsection in which the species are known to occur and/or habitat is present.

Since this project is wide-ranging, would be completed in a longer time span of over 10 years, and may affect bat species that can forage over longer distances, a 5-mile buffer was established for the cumulative effects geographical boundary.

Based on approximate time of the project duration, the cumulative effects temporal boundary is 20 years.

Direct and Indirect Effects

Eastern fanshell, rough pigtoe, and sheepsnose mussel

Within the vicinity of the proposed project, there is no habitat for, and no known records of the eastern fanshell, rough pigtoe, or sheepsnose mussel (IDNR 2012, 2015). Therefore, there would be no direct, indirect or cumulative effects to these species from implementing this project.

Gray Bat

The gray bat is Indiana's only true cave bat, requiring caves for roosting, breeding, rearing young, and hibernation. Summer habitat requirements for the gray bat include forests near permanent water and caves (NatureServe 2019). There is no designated critical habitat for the gray bat on the Hoosier National Forest.

The gray bat occupies caves for winter hibernation and possibly a different cave for summer roosting. It is not found roosting in trees or foliage. After over 15 years of cave surveys during the winter and summer months, there are no records of caves being used by gray bats on the Hoosier National Forest. There are no known caves inside the project area. Caves over 3.5 miles from the project boundary have been inspected and not shown to have gray bats (Harriss 2018, Lewis 2011).

Project activities may affect summer habitat, foraging habitat and travel corridors but it is not likely to adversely affect this species. Effects to summer habitat would be staggered over 10-20 years and would not occur all at one time. Project activities would show long-term improvements to water quality and riparian habitat, increase in plant and insect diversity, and an increased water supply by vernal pool creation.

Indiana Bat

There are occurrences of the Indiana bat, according to the Indiana Natural Heritage Data Center, within the action area (IDNR 2012, 2015). The most recent in 2010, a single male Indiana bat was captured just over six miles from the action area (McClanahan 2010). It is assumed that they are present in the vicinity because potential habitat exists inside and adjacent to the project area. There is no designated critical habitat for the Indiana bat on the Hoosier National Forest.

The nearest known Indiana bat hibernacula is approximately 16 miles away from the project area. Because there are no known hibernacula in or near the action area, the proposed Houston South Project would not directly or indirectly affect hibernacula of the Indiana bat nor affect swarming/staging behavior of the Indiana bat.

Timber harvest has the potential to directly or indirectly harm Indiana bats in the short-term. The removal of potential roost trees and alternate roost trees during the bat's active season would have possible direct and indirect effects to the Indiana bat. Habitat may be affected in the short-term, but project activities may show long-term improvements. This

includes improved foraging and roosting habitat, small gaps creation in the forest canopy allowing increased solar exposure for maternity colonies, new travel corridor creation, and the addition of vernal pools as a water source. Standards and guidelines from the Forest Plan would ensure that timber harvest is done to maximize the benefit to Indiana bats (USDA FS 2006a).

Indiana bats are very well adapted to modifications to their habitat (Gardner et al. 1991) and they have responded to fires throughout their species' existence. They can be considered a fire-adapted species since the majority of its range historically consisted of fire-maintained ecosystems. It is reasonable to predict that adult Indiana bats would successfully flee from burn areas (USDI FWS 2006). Non-volant pups cannot respond if their roost tree is engulfed by fire or exposed to smoke. However, maternity roosts are protected by Forest Plan guidance of restricting prescribed burning within a one-mile radius from occupied roosts during the breeding season (USDA FS 2006a).

The vast majority of prescribed burns would not occur during bat's active period of April 15 to September 15. However, this project was designed to take advantage of potentially longer burn windows and prescribed burn activities could occur during the active period for bats to reach desired conditions.

This project would have no additional effects on the Indiana bat beyond those previously identified and evaluated in the Hoosier National Forest Programmatic Biological Assessment (USDA FS 2005) and the USDI Fish and Wildlife Service Biological Opinion of the Hoosier National Forest Land and Resource Management Plan (USDI FWS 2006).

Northern long-eared bat

There are no known occurrences of the northern long-eared bat within the area of the proposed actions according to the Indiana Heritage Database. The Hoosier National Forest has no critical habitat for this bat species. No known hibernacula exist in the project area. The closest hibernaculum is over 3.5 miles away and there are no known northern long-eared bat maternity trees in the vicinity of the project area. It is assumed however, they are using habitat in the area, but there has been no documentation of northern long-eared maternity roosts on the forest. Suitable spring staging/fall swarming habitat for northern long-eared bat is most typically within 5 miles of a hibernaculum (USDI FWS 2014).

White-nose syndrome (WNS) is known to occur in this species. The northern long-eared bat has experienced sharp declines as evidenced in hibernacula surveys (Harriss 2018). White-nose syndrome is the primary factor affecting the status of the northern long-eared bat, resulting in the local extirpation of the species in some areas. Negative impacts resulting from proposed activities would not exacerbate the effects of WNS at the scale of states within its range.

Project activities should not affect winter hibernacula of the northern long-eared bat directly or indirectly. Project activities may affect summer habitat, swarming/staging

habitat, roosting habitat, foraging habitat and travel corridors. Effects are believed to be short-term with project activities showing long-term improvements with increased solar exposure for maternity colonies, potential roost creation, increase in better foraging potential, and an increased water supply by vernal pool creation.

The proposed Houston South Project could affect swarming/staging behavior of the northern long-eared bat, due to prescribed burn activity and timber operations. Timber operation effects to summer, swarming/staging habitat, roosting, foraging habitat and travel corridors are believed to be short-term with long-term benefits.

Because there are no known hibernacula within 0.25 miles of the action area and there are no known maternity roost trees in the action area, incidental take from tree removal activities and prescribed fire is not prohibited under the final 4(d) rule for northern long-eared bat (USDI FWS 2016).

Cumulative Effects

There are no municipal, county, or state projects known to be proposed within the analysis area. However, it is assumed that standard maintenance on highways, county roads and rights-of-way would continue. Past activities that have likely affected Federally listed species include conversion of riparian areas to agricultural or residential uses, timber harvest, wildfire and grazing.

Present or reasonably foreseeable future activities, which may have an impact on these species, include the construction or use of roads, continued agricultural use, timber harvest and activities associated with residential development. Private lands near the proposed action area will continue to be a mix of forest, open pasture and crop fields.

The past, present or foreseeable Forest Service activities near the action area that could potentially cause additive or synergistic adverse cumulative impacts in conjunction with the proposed action are: the continuation of early successional management (Forest Openings Maintenance), wetland maintenance, the Buffalo Pike Project, potential trail re-routes, Pleasant Run Road Decommissioning, Lake and Pond Habitat Improvement, Jackson County AOPs, Fork Ridge Restoration and NNIS herbicide applications. The vast majority of these activities are considered not likely to adversely affect the Indiana bat and have a beneficial effect on local bat species.

Since the Houston South Project would not alter or create habitat suitable for the fanshell mussel, sheepsnose mussel or rough pigtoe mussel. The project would contribute no cumulative impacts to these species.

The Buffalo Pike Project BE (Harriss 2014b) did not consider the gray bat to be present. As a result, a no effect determination was used for all bat components of this species. Therefore, there are no cumulative effects for the gray bat.

The only project that was likely to adversely affect the Indiana bat or northern long-eared bat was the Buffalo Pike Project. Timber operations have been completed for this project

and incidental take for the Indiana bat has been accounted for in the Biological Opinion (USDI FWS 2006). Any negative effects are no longer occurring. Indirect beneficial effects would be ongoing such as vernal pool installments, new roosting tree creation, and increased solar exposure. Therefore, cumulative effects from both projects could occur but no negative effects are anticipated.

10) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

Implementation of the proposed action would not threaten a violation of Federal, State, or local law. The proposed action complies with the National Forest Management Act (NFMA), Endangered Species Act (ESA), Clean Water Act, and the National Historic Preservation Act (NHPA). The proposed action is fully consistent with the Hoosier National Forest Land and Resource Management Plan (USDA FS 2006a) as amended.

Agencies or Persons Consulted

The Forest Service consulted the following individuals, Federal, State, Tribal, and local agencies during the development of this EA:

USDI Fish and Wildlife Service

US Army Corps of Engineers

Indiana Department of Natural Resources

Absentee Shawnee Tribe of Oklahoma

Delaware Tribe of Oklahoma

Eastern Shawnee Tribe of Oklahoma

Miami Tribe of Oklahoma

Peoria Tribe of Indians of Oklahoma

Shawnee Tribe

Comments were also sought from organizations and individuals, including landowners adjacent to the project areas.

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Appendix A - Design Measures

The ID team incorporated management requirements and design measures in the project design to reduce any potential negative impacts of the project. We do not list all Forest Plan standards and guidelines (USDA 2006a) and statewide best management practices (BMPs) here, but they are required of implementers of the project.

Table 10: Design Measures

SITUATION TO BE PREVENTED OR AMELIORATED	MEASURE	RESPONSIBILITY OF
Cultural Resources		
Damage to cultural resource sites	Adequate buffer zones (20 meters in width) will be established and flagged on the ground to avoid all cultural resource sites that require protection during treatment activities.	Heritage resource specialist
Damage to cultural resource sites	Adequate buffer zones (30 meters in width) will be established and marked on the ground to avoid all cemeteries	Heritage resource specialist
Damage to cultural resource sites	Cultural resource sites that require protection from fire will have a buffered fire line laid in with foam or a leaf blower. Regardless of the method, heavy downed fuels located on-site should be hand removed, if possible.	Heritage resource specialist, prescribed burn specialist
Damage to cultural resource sites	If cultural materials or human remains are discovered during project implementation, immediately cease work and notify the Heritage Resource Specialist.	All Implementers
Damage to cultural resource sites	Conduct cultural resource surveys of private lands prior to implementation of prescribed burning or ground disturbance during road construction and reconstruction.	Heritage resource specialist, prescribed burn specialist, engineering
Damage to cultural resource sites	Motorized vehicle/machine work will be limited in duration and occur in favorable weather conditions to avoid ground disturbance at protected sites.	All Implementers
Damage to cultural resource sites	Cut trees near protected sites so they fall away from site features and site boundary.	All Implementers
NNIS		
Potential spread of NNIS plants	Clean equipment before entering work areas. Include equipment cleaning clause in all timber contracts.	Contract administrator
Potential spread of NNIS plants	Clean all equipment to be used for burn implementation (Rx equipment, fire line creation) prior to entry onto the Hoosier Forest.	Prescribed burn specialist/burn boss
Potential NNIS germination and establishment	Reseed disturbed areas created at log landings. Consider reseeding disturbed areas along fire lines, as needed. Use either the Hoosier National Forest seed mix or consult with Forest Botanist on species composition of seed mix.	Timber sale administrator and prescribed burn specialist/burn boss

Herbicide Application		
Effect of herbicides on non-target vegetation	Choose a method that, when applied directly, targets the undesirable plants with little over-spray (e.g. cut-stump, basal bark, hack-n-squirt).	Herbicide applicators
Effect of herbicides on non-target vegetation	Apply herbicide when adjacent native plants are dormant (early spring or late fall).	Herbicide applicators
Effect of herbicides on non-target vegetation	If application is necessary during the growing season, use selective herbicides or a selective method of application to reduce effects to the surrounding non-target vegetation.	Herbicide applicators
Effect of herbicides on non-target vegetation	Apply only formulations approved for aquatic use in or next to surface waters. Minimize the use of triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) within ephemeral, intermittent or perennial stream corridors, or within 100 feet of lakes, ponds or wetlands.	Herbicide applicators
Effect of herbicides on non-target vegetation	Follow label directions and not exceed any mixing or application rates. In addition, temporarily close treatment areas when warranted (e.g. heavily used trails near treatments).	Herbicide applicators
Prescribed Fire		
Excess smoke in the air locally	Before beginning ignition, ensure smoke dispersal forecasts as issued by the National Weather Service are conducive to minimizing smoke impacts.	Prescribed burn specialist/burn boss
Excess smoke in the air locally	Do not ignite fire when the area is in nonconformity or when air quality alerts have been issued for the area.	Prescribed burn specialist/burn boss
Excess smoke in the air locally	Develop burn plan parameters that moderate fire behavior.	Prescribed burn specialist/burn boss
Excess smoke around smoke-sensitive targets	Burn only when wind directions would keep smoke away from smoke-sensitive targets.	Prescribed burn specialist/burn boss
Prescribed fire escaping or damaging property	Keep fuel concentrations away from perimeters, power lines, and residences.	Prescribed burn specialist/burn boss
Soil and Water		
Erosion	Erosion control measures will be kept concurrent with operations as dictated by ground and forecasted weather conditions.	Timber sale administrator
Reduce the risk of erosion and to avoid effects to riparian areas	Skid roads and log landings are to be located to minimize soil and stream buffer disturbance; avoid or limit the number of functioning stream crossings; use existing old skid routes where desirable; and avoid the steeper and wetter areas within the units and areas of disturbance when practical. Skid trails should not exceed 35% slope. Consult with soil scientist, fisheries biologist, or botanist to approve log landing locations as needed.	Timber sale administrator
Minimize compaction, rutting, puddling,	Operate tracked or rubber-tired equipment when soils are most resistant to compaction and rutting. Conduct equipment operation between June 1 and	Timber sale administrator

ponding, and soil movement	November 15, when soils are not saturated, unless authorized by a FS representative if suitably dry or frozen soil conditions allow.	
Minimize compaction, rutting, puddling, ponding, and soil movement	Suspend skidding/hauling during periods where soils are: saturated due to high levels of precipitation when air temperatures are above freezing; thawing during winter months after periods of being frozen; and under any other conditions that would appear to be saturated.	Timber sale administrator
Soil movement into streams	Install erosion control measures along road construction when inside filter strips.	Engineering, contractors
Subsurface flows to the surface and creating new water ways on steep hill slope; severe rutting and compaction	To protect areas where water comes to the surface and runs down a skid road, limbs and tops can be placed on the road surface to be run over by equipment to act as a cushion and disperse the weight of heavy equipment thereby preventing severe rutting and compaction.	Timber sale administrator
Minimize sediment reaching streams	Leave a 25 foot no cut filter strip along perennial streams.	Timber sale Administrator and sale prep personnel
Effects to soil and water	In riparian corridors (25 feet for ephemeral, 50 feet for intermittent, and 100 feet for perennial), operate tracked or rubber-tired equipment when soils are most resistant to compaction and rutting.	Timber sale Administrator
Recreation		
Effects to trails	Restore trail tread to its original condition as much as possible after treatment and in a timely manner. Operations including: repair to waterbars, removal of slash and debris, smoothing of ruts in trails, removal of overhead hazards, and brushing in widened trail corridors.	Engineering, recreation personnel, contract administrator
Possible negative effects on Visuals	Lop and scatter slash adjacent to the Hickory Ridge and Fork Ridge Trails for 25 feet.	Contract administrator
Transportation		
Sedimentation in drainage	Install temporary culverts for access for right-of-ways, logging and road construction	Engineering, contractors
Possible negative effects on Visuals	Chip or bury slash generated from roadwork on the trail where practicable.	Engineering, contractors
Possible negative effects to Aquatic Organism Passages	Use bridges, bottomless pipes, or fords to meet guidelines for AOP crossings on drainages.	Engineering, sale administrator
Sediment movement	Install erosion control devices, keep equipment out of drainages, except at approved crossings	Engineering, sale administrator
Wildlife		
Effects to bats	Remove hazard trees for fire line prep prior to April 15 and after September 15	Prescribed burn specialist/burn boss
Effects to bats	Remove midstory and crop tree release prior to April 15 and after September 15	Silviculturist

Effects to bats	Implement Standards and Guidelines from the Forest Plan, maximize the benefit to Indiana bats and protect the gray bat (USDA FS 2006a) pages 3-3 through 3-5)	All implementers
Effects to sensitive species	Dates of prescribed burning and fire line placement may need re-evaluated based on future sensitive species research findings. Coordinate with the wildlife biologist on current findings	Wildlife biologist
RFSS Plants		
Effects to RFSS Plants	Protect known populations of American ginseng from impacts during timber logging activities and fire line construction.	All Implementers
Effects to RFSS Plants	Do not cut or damage any butternut trees without having them evaluated for healthiness. Stop all activity around any butternuts discovered during implementation and protect trees from disturbance until they can be assessed by a Biologist/Silviculturist for butternut canker resistance.	All Implementers
Effects to RFSS Plants	Report any newly found populations of RFSS to the Forest Botanist and protect them from direct impacts during timber logging activities and fire line construction.	All Implementers